BAJOCIAN SONNINIIDAE AND OTHER AMMONITES FROM WESTERN SCOTLAND

by NICOL MORTON

ABSTRACT. The sequence of Bajocian ammonites in the Bearreraig Sandstone of Skye is summarized in terms of a modified scheme of zones or subzones: Discites, Ovalis, Laeviuscula, Sauzei (with subzone Sauzei and a new upper subzone Hebridica), and Humphriesianum (with subzones Cycloides, Humphriesianum, and Blagdeni). The first three are used informally to replace Sowerbyi, but Sauzei and Humphriesianum, with subzones as above, can be regarded as part of a formal Lower Bajocian zonal scheme. Upper Bajocian zones cannot yet be distinguished in Skye. Part of the family Sonniniidae is modified and discussed, and the species of *Euhoploceras* (with subgenera *Euhoploceras* and *Fissilobiceras*), *Shirbuirnia*, *Witchellia*, *Pelekodites*, *Sonninia* (with subgenera *Sonninia* and *Papilliceras*), and *Dorsetensia* which are present in western Scotland are described, together with some other ammonites. There is clear dimorphism in some of the faunas, for example *Witchellia* (M) and *Pelekodites* (m), but *Pelekodites* (m) also occurs with *Sonninia* (M+?m), and pairing of dimorphs is obscure and so not attempted. Some species in Scotland are slightly dwarfed in comparison with other parts of Europe.

BAJOCIAN ammonites occur in western Scotland mainly in the Bearreraig Sandstone in the Trotternish peninsula of the Isle of Skye, although they have also been recorded in Mull (Lee and Bailey 1925). The fauna is dominated by species of stephanoceratids (Morton 1971*a*) and sonniniids (Morton 1972, 1973), and the purpose of this paper is to describe the Sonniniidae and some other Bajocian ammonites.

The specimens described are mainly in the collections of the Hunterian Museum, University of Glasgow (HM), but some are from the collections of the Institute of Geological Sciences, Edinburgh (GSE), Dr. J. H. Callomon, London (Call.) and the Department of Geology, Birkbeck College, London (BkC).

STRATIGRAPHY

The lithostratigraphy is based on Morton (1965, 1969) (see also Lee 1920 and Anderson and Dunham 1966). The sequence of faunas and their zonal or subzonal position (see Table 1) are:

1. Bearreraig Burn section; 17 m above base of Shaly Sandstones: *Euhoploceras* (*E.*) ?*dominans* (Buckman), *E.* (*E.*) *marginata* (Buckman)—top of Concavum Zone (Aalenian) or base of Discites Zone (*Hyperlioceras* sp. occurs 1–2 m higher).

2. Bearreraig Burn section; 26 m, 27 m, and 29 m below top of Shaly Sandstones (44 m above base): *Euhoploceras* (*E.*) spp. (? cf. *modestum* (Buckman) and ? cf. *costatum* (Buckman))—Discites Zone.

3. Bearreraig Burn section and foot of high cliff 400 m south of Bearreraig; top 2–3 m of Shaly Sandstones: *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen), *E.* (*E.*) sp. (? cf. *adicrum* (Waagen)), *Shirbuirnia trigonalis* Buckman—Ovalis Zone.

4. Bearreraig Burn section; 18 m below top of Massive Sandstones: *Witchellia* aff. *rubra* (Buckman), *W.* aff. *laeviuscula* (Sowerby), *W.* aff. *romanoides* (Douvillé), *Pelekodites zurcheri* (Douvillé), *P. macer* (Buckman), *P. minimus* (Hiltermann), *Sonninia* (*S.*) *corrugata* (Sowerby), *Emileia* (*Otoites*) sp. nov.—Laeviuscula Zone (also loose *Sonninia* (*Papilliceras*) *arenata* (Quenstedt) from Sauzei Zone).

5. Rudha Sughar, Bearreraig; loose blocks from top 10–12 m of Massive Sandstones: *Sonninia* (*S.*)

[Palaeontology, Vol. 18, Part 1, 1975, pp. 41–91, pls. 6–17.]

cf. *sowerbyi* (Sowerby), *S.* (*S.*) cf. *propinquans* (Bayle), *S.* (*S.*) *corrugata* (Sowerby), *S.* (*Papilliceras*) *arenata* (Quenstedt), *S.* (*P.*) *mesacantha* (Waagen), *Pelekodites macer* (Buckman), *Strigoceras bessinum* Brasil, *Emileia* (*E.*) sp.—Sauzei Zone and Subzone. A single specimen of *Witchellia* aff. *rubra* (Buckman) suggests that some Laeviuscula Zone may also be present.

6. Torvaig, near Portree; basal bed of Upper Sandstones: *Stephanoceras* (*St.*) *nodosum* (Quenstedt), *St.* (*St.*) aff. *nodosum* and aff. *macrum* (Quenstedt), ?*Chondroceras evolvescens* (Waagen), *Lissoceras oolithicum* (d'Orbigny), *Dorsetensia pinguis* (Roemer), *D. hannoverana* (Hiltermann), *D. hebridica* Morton, '*Sonninia*' aff. *furticarinata* (Quenstedt)—Hebridica Subzone, Sauzei Zone. Formerly placed (Morton 1971*a*, 1972) in the lower part of the Humphriesianum Zone, the basal part of the Upper Sandstones containing this fauna is now excluded from the Humphriesianum Zone and placed in the Sauzei Zone as a new subzone. It can be correlated with the Pinguis-Schichten of northern Germany (see Huf 1968; Westermann 1967, p. 123).

7. Rigg shore; lower part of Upper Sandstones:

(*a*) Near waterfall and southwards along shore: *Oppelia* (*O.*) ?*subradiata* (Sowerby), *Stephanoceras* (*St.*) *mutabile* (Quenstedt), *St.* (*St.*) *nodosum* (Quenstedt), *St.* (*St.*) sp., *St.* (*Normannites*) ?*orbignyi* (Buckman), *St.* (*N.*) ?*densum* (Buckman), *Chondroceras evolvescens* (Waagen), *Dorsetensia liostraca* Buckman, *D. romani* (Oppel), '*Sonninia*' aff. *furticarinata* (Quenstedt), *Poecilomorphus cycloides* (d'Orbigny)—Cycloides Subzone, Humphriesianum Zone.

(*b*) North of waterfall, stratigraphically higher than (*a*): *Stephanoceras* (*St.*) *mutabile* (Quenstedt), *St.* (*St.*) aff. *triplex* Weisert, *St.* (*Normannites*) ?*orbignyi* (Buckman), *St.* (*N.*) ?*densum* (Buckman)—Humphriesianum Subzone, Humphriesianum Zone.

8. Rudha Sughar, Bearreraig; loose blocks from basal 30 m of Upper Sandstones: *Oppelia* (*O.*) ?*subradiata* (Sowerby), *Stephanoceras* (*St.*) *mutabile* (Quenstedt), *St.* (*St.*) aff. *brodiaei* (Sowerby), *St.* (*St.*) aff. *nodosum* and aff. *macrum* (Quenstedt), *St.* (*St.*) aff. *triplex* Weisert, *St.* (*St.*) *pyritosum* (Quenstedt), *St.* (*Normannites*) ?*orbignyi* (Buckman), *Dorsetensia liostraca* Buckman, *D. romani* (Oppel), *D. pinguis* (Roemer), '*Sonninia*' aff. *furticarinata* (Quenstedt)—Hebridica Subzone, Sauzei Zone and Cycloides and Humphriesianum Subzones, Humphriesianum Zone.

9. Pipe-line cutting at Bearreraig; 30 m above base of Upper Sandstones: *Stephanoceras* (*St.*) *pyritosum* (Quenstedt), *St.* (*St.*) aff. *triplex* Weisert, *St.* (*Normannites*) sp.—Humphriesianum Zone and Subzone.

10. Pipe-line cutting at Bearreraig; 4 m above fauna 9, 34 m above base of Upper Sandstones: *Teloceras* (*T.*) *blagdeni* (Sowerby)—Blagdeni Subzone, Humphriesianum Zone.

Apparent ranges of species occurring in the Upper Sandstones (excluding fauna 8) are:

	Hebridica	Cycloides	Humphriesianum	Blagdeni
Oppelia (*O.*) ?*subradiata*		×		
Lissoceras oolithicum	×			
Stephanoceras (*St.*) *nodosum*	×	×		
St. (*St.*) aff. *nodosum* and aff. *macrum*	×	×		
St. (*St.*) *mutabile*		×	×	
St. (*St.*) aff. *triplex*			×	
St. (*St.*) *pyritosum*			×	
St. (*N.*) ?*orbignyi*		×	×	
St. (*N.*) ?*densum*		×		
Teloceras (*T.*) *blagdeni*				×
Chondroceras evolvescens	?	×		
Dorsetensia liostraca		×		
D. romani		×		
D. pinguis	×			
D. hannoverana	×			
D. hebridica	×			
'*Sonninia*' aff. *furticarinata*	×	×		
Poecilomorphus cycloides		×		

11. Bearreraig; loose block presumably from upper part of Upper Sandstones, found by Dr. J. K. Wright: *Garantiana* (*G.*) ?*baculata* (Quenstedt) (i.e. = Morton 1971*a*, p. 287)—Subfurcatum or lower part of Garantiana Zone. (HMS 26429—pl. 16, figs. 9–10.)

12. Prince Charles's Cave; Garantiana Clay: *Garantiana* (*G.*) ?*baculata* (Quenstedt) (Morton 1971*a*, p. 287) or *Pseudogarantiana dichotoma* (Bentz) (Pavia 1973, p. 110)—Subfurcatum or lower part of Garantiana Zone.

TABLE 1. Divisions of the Bajocian Stage recognized in western Scotland

SUBSTAGES	ZONES OR SUBZONES	
Upper Bajocian	Garantiana or Subfurcatum	
Lower Bajocian	Humphriesianum	Blagdeni
		Humphriesianum
		Cycloides
	Sauzei	Hebridica
		Sauzei
	Laeviuscula	
	Ovalis	
	Discites	

DIMENSIONS

Below is a full list of the dimensions given, though not all are appropriate for every species described (all lengths are in mm):

D Diameter of specimen.

Wh Whorl height $\left(H = \frac{Wh \times 100}{D}\right)$.

Wb Whorl breadth $\left(B = \frac{Wb \times 100}{D}\right)$.

W A measure of whorl shape $= \frac{Wb \times 100}{Wh}$.

Ud Diameter of umbilicus $\left(U = \frac{Ud \times 100}{D}\right)$.

Vw Width of venter, in round brackets where the edges of the venter are not distinct $\left(V = \frac{Vw \times 100}{D}; Vb = \frac{Vw \times 100}{Wb}\right)$.

Rd Average distance between ribs where Wh was measured $\left(R = \frac{Rd \times 100}{D}\right)$, using prefixes ^{p}R and ^{s}R where appropriate to indicate primary or secondary ribs respectively.

Rn Number of ribs per whorl or part of whorl as specified, counting from the point where Wh was measured towards the apex.

Td Average distance between tubercles where Wh was measured $\left(T = \frac{Td \times 100}{D}\right)$. A 'd' for Td, Tn, and Tc indicates that the tubercles decline within the distance normally measured.

Tn Number of tubercles per whorl or part of whorl as specified, counted as for Rn.

Tc Number of tubercles in the part of the whorl between where Wh was measured and 5 cm adapically along the whorl sides (only on larger specimens).

C Length of body chamber, measured as the angle subtended about the protoconch by the umbilical end of the aperture and the tips of the saddles of the last septum, in square brackets if the body chamber is incomplete.

S A measure of sutural complexity, based on the amount of indentation of the sides of the lateral lobe compared with the length of the lobe. The amount of indentation is derived by subtracting from the maximum width (SLo) of the lobe the minimum distance (SLi) between the sides of the adapertural part of the lobe (before subdivision). Both are measured in a direction at right angles to the tangent to the venter where the suture crosses the venter. The length of the lobe (SLl) is the orthogonal distance from a line joining the tips of the neighbouring saddles to the tip of the lobe. This may not be at right angles to SLo and SLi. Thus

$$S = \frac{(SLo - SLi) \times 100}{SLl}.$$

This is a measure of the complexity of the suture rather than the size of the lobe, and gives high values of S for complex deeply indented lobes.

'A' or 'P' before the measurements for the diameter indicate that the measurements were made at the aperture or at the end of the phragmocone respectively, while 'c' before any measurement indicates that it is approximate.

Original data for species represented by two or more specimens are not published here, but are deposited with the British Library, Boston Spa, Yorkshire, as supplementary Publication No. SUP 14005 (twenty pages). For these species mean and standard deviation (in round brackets) have been calculated for those dimensions which show little or no variation with growth. Dimensional relationships which are growth variant are expressed by means of regression equations, with the mean square deviation about the regression in square brackets. These are intended partly for comparison of species, but mainly to provide population data for eventual comparison with populations from other areas. The number of observations (cf. number of specimens) is indicated, since most specimens have been measured at at least two or three stages of growth.

Most of the specimens have not been significantly affected by post-burial distortion, but dimensions affected by distortion are indicated by an asterisk.

SYSTEMATIC DESCRIPTIONS

Superfamily HILDOCERATACEAE Hyatt, 1867
Family SONNINIIDAE Buckman, 1892

The generic classification used is modified from Arkell (1957). The basis for the recognition of the genera is as follows (see also Table 2).

Euhoploceras. Distinguished from *Sonninia* (s.s.) by having broader more quadrate whorls, distinct subtabulate (or even bisulcate) venter (V = 9·3 and 8·4, not measurable in *Sonninia*), and low keel. *Fissilobiceras* is included here because of similarities in whorl shape, distinct flattened venter, and low keel, but recognized as subgenus because it is smoother, more involute (U = 26·8 cf. 40·0), and has a more complex suture (S = 67·6 cf. 60·0).

Shirbuirnia. Distinguished from *Euhoploceras* by trigonal rather than subquadrate whorl shape, with fastigate venter not distinct from whorl sides (V not measurable); from *Sonninia* by different whorl shape (with maximum whorl breadth lower in whorl cross-section), low keel, and simpler suture; from *Witchellia* in lacking a tabulate venter; and from large specimens of *Dorsetensia* by broader whorls.

Witchellia. Distinguished from *Euhoploceras* in being more involute (U = 29·8 cf. 40·0 for *Euhoploceras* excluding *Fissilobiceras*) and more compressed, by broader more distinctly tabulate venter (V = 12·5 cf. 8·7) and simpler suture (S = 35·0); from *Sonninia* in having tabulate venter and simpler suture; from *Dorsetensia* see Morton (1972, p. 505).

TABLE 2. Mean and standard deviation of selected characters of sonniniid genera based on specimens from Skye. N indicates the number of measurements available rather than number of specimens—for most specimens sets of measurements at more than one diameter are available.

	N[1]	H		U		V		N[1]	S	
		$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ		$\bar{x}$	σ
Euhoploceras (*Euhoploceras*)	6	36·0	2·6	40·0	4·1	9·3	1·5	1	60·0	—
Euhoploceras (*Fissilobiceras*)	12	43·4	6·0	26·8	5·6	8·4	1·2	5	67·6	10·1
Witchellia	135	43·4	3·3	29·8	4·5	12·5	3·6	21	35·0	6·5
Pelekodites	137	39·5	2·9	34·3	3·2	12·9	2·5	14	35·5	6·1
Sonninia	138	41·4	3·1	32·5	3·4	0†	—	33	64·1	7·7
Dorsetensia	100	43·7	3·9	28·2	5·3	11·5*	4·2*	23	39·4	9·2
'*S.*' aff. *furticarinata*	12	46·2	2·6	24·3	4·2	10·6	1·5	2	62·5	—

* Excluding *D. liostraca* which has an acutely fastigate venter.
† Venter of *Sonninia* acutely fastigate, not distinct from whorl sides.
[1] Number of measurements, *not* number of specimens.

Pelekodites. As defined at present includes the great majority of known sonniniid microconchs from the old Sowerbyi Zone, but may disappear if constituent species can be paired with macroconch synonyms, e.g. *Witchellia* (Westermann 1969*a*, pp. 115–116), or *Sonninia* (Westermann and Riccardi 1972, pl. 10, fig. 3). Reasons for retention are discussed below. Distinguished from most by small size and simpler sutures (S = 35·5); from *Witchellia* and *Dorsetensia* by being more evolute (U = 34·3 cf. 29·8 and 28·2) and having squarer whorl cross-section.

Sonninia. Characterized by being more compressed with acutely fastigate venter not distinct from whorl sides, high keel, and complex suture (S = 64·1 cf. 39·4 in *Dorsetensia* which may be otherwise similar except in details of radial line and style of ornamentation). *Papilliceras* is recognized as subgenus distinguished by the development of mid-lateral tubercles (or papillae) on body chamber (cf. Arkell 1957, p. L268, who stated merely that tubercles persist on to body chamber in some). Some species of *Sonninia* (*Sonninia*), including the type of *S.* (*S.*) *propinquans* (Bayle), may have developed tubercles on the body chamber if they were more complete and fully grown, and the subgenera may not be as distinct as apparent at present (see also Westermann and Riccardi 1972, pp. 47, 73–77, and Imlay 1973, p. 5).

'*Sonninia*.' The precise systematic position of '*Sonninia*' aff. *furticarinata* (Quenstedt) is not clear (see p. 80).

Dorsetensia. See Morton (1972, p. 505).

The family ranges from Concavum Zone (Aalenian) (if the base of the Discites Zone is defined by the appearance of *Hyperlioceras* (Morton 1971*b*)) to Lower Bathonian (Arkell 1951), with acme in Lower Bajocian. Important monographs include Buckman 1887–1907, 1909–1930, Haug 1893, Dorn 1935, Spath 1936, Gillet 1937, Hiltermann 1939, Roché 1939, Maubeuge 1951, 1955, Oechsle 1958, Imlay 1964, 1973, Westermann 1969*a*, Westermann and Riccardi 1972.

Dimorphism is very marked in some sonniniid faunas from Skye, for example in the concurrence of *Witchellia* as macroconch and *Pelekodites* as microconch, but in other faunas, for example *Euhoploceras*, it is not at all clear and there is a distinct

'shortage' of microconchs (see also Westermann 1966, 1969*a*). It is possible that the microconchs have been 'lumped' into the one genus *Pelekodites*, but if my earlier interpretation (Morton 1972) of *Dorsetensia* is correct then there may also be unrecognized dimorphism within some sonniniid genera as currently defined. Westermann and Riccardi (1972) describe and figure male and female of some species. In some cases the association seems highly likely, though hardly proved conclusively, and 'marriage' into one species may be appropriate. However, in most cases the association is somewhat tenuous and does not provide a sound basis for revision of sonniniid taxonomy into bisexual biospecies (and this is not considered desirable by some authors—see discussions in Westermann 1969*b*). This should be based on more than one local fauna. Therefore no attempt is made to deal with sonniniid dimorphism other than as separate taxonomic categories, as has Imlay (1973).

Genus EUHOPLOCERAS Buckman, 1913
Subgenus EUHOPLOCERAS (EUHOPLOCERAS) Buckman, 1913

Type species. Sonninia acanthodes Buckman, 1889, original designation by Buckman (1913, p. 4).

Includes. Sherbornites and *Stiphromorphites* Buckman, 1923.

Discussion. The many species of *Euhoploceras*, mainly from Bradford Abbas (Dorset), described by Buckman were referred by Westermann (1966) to a single species *adicra* (Waagen) on the basis of semi-quantitative work on Buckman's plates. There are undoubtedly too many specific names, but Westermann's 'sample' can hardly be said to be adequate to establish the continuity or otherwise of the variation in such a morphologically diverse group. Furthermore, the 0·18 m of the Discites Zone at Bradford Abbas is equivalent to some 35–40 m of strata at Bearreraig, so that it is simply not true to say (cf. Westermann 1966, p. 291) that the Bradford Abbas 'discites bed' is not condensed. Also the assumption that Buckman's specimens all came from one zone or subzone is not justified (see Barker and Torrens 1971, p. 55). Until a revision of the Dorset sonniniids, the specimens from Skye will be compared with Buckman's 'species' rather than lumped into Westermann's enlarged species *adicra*. Similar conclusions were arrived at by Imlay (1973, pp. 4–6).

Euhoploceras (*Euhoploceras*) *marginata* (Buckman)

Plate 6, figs. 2–3

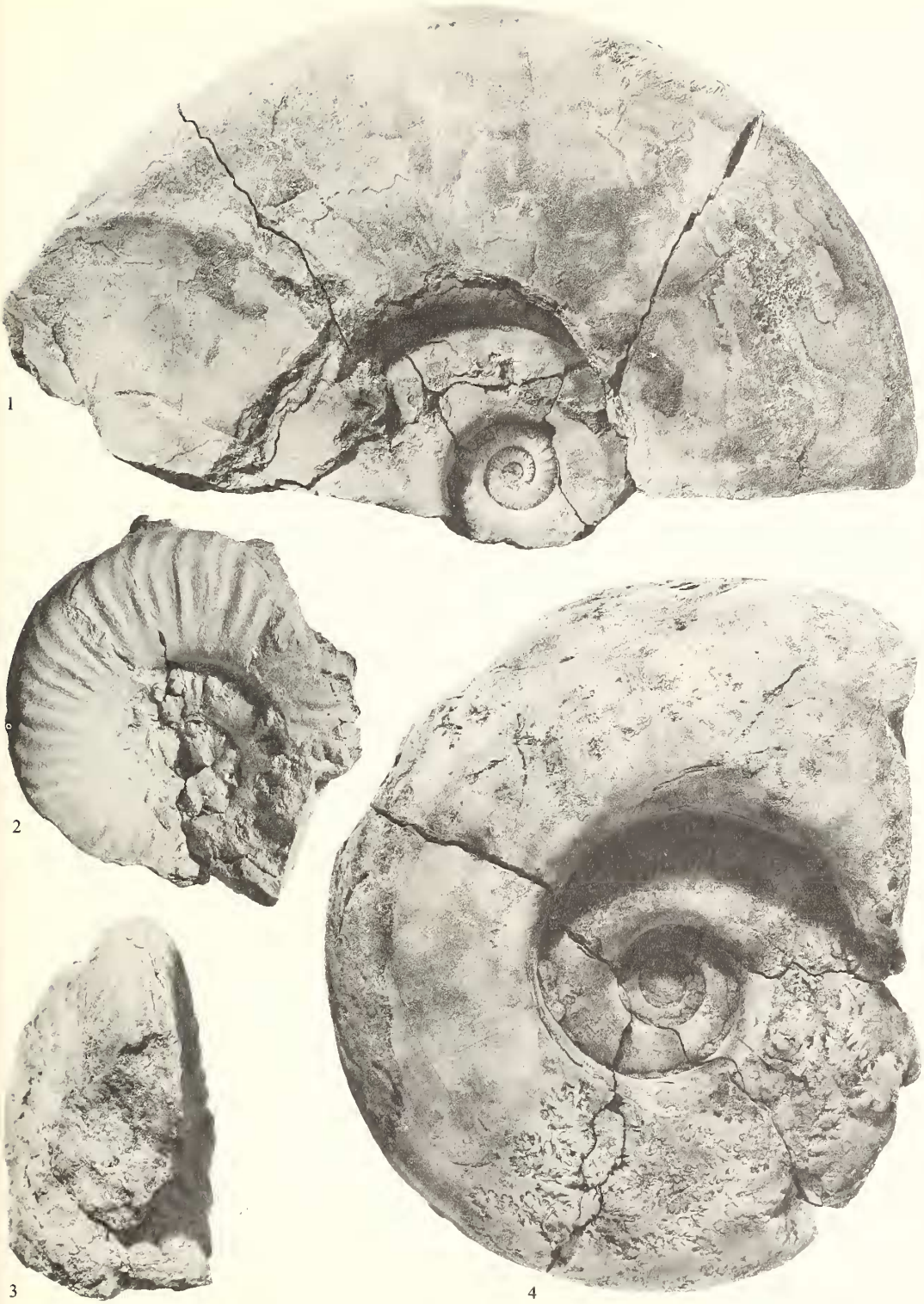
1892 *Sonninia marginata* S. Buckman, pp. 321–322, pl. 62; pl. 63, fig. 2; pl. 65, figs. 1–2.
1894 *Sonninia marginata* S. Buckman, pp. 387, 407, pl. 94, fig. 6.
1937 *Sonninia marginata* Buckman, Gillet, p. 53.

EXPLANATION OF PLATE 6

Fig. 1. *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen); HMS 26399/1; Ovalis Zone; top 2–3 m of Shaly Sandstones, foot of high cliff 300 m north of Holm, Trotternish, Skye, ×0·63.

Figs. 2, 3. *Euhoploceras* (*Euhoploceras*) *marginata* (Buckman); HMS 26398; top of Concavum Zone or base of Discites Zone; 17 m above base of Shaly Sandstones, lowest exposure in Bearreraig Burn, Trotternish, Skye, ×1.

Fig. 4. *Shirbuirnia trigonalis* Buckman; HMS 15342/1; Ovalis Zone; horizon and locality as fig. 1, ×0·44.



MORTON, Scottish Bajocian ammonites

Material. One medium-sized specimen, HMS 26398.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	Vw	V	Vb	Rd	R	Rn	C
c. 55·0	19·8	36	18·0	33	91	23·9	43	(6·5)	(12)	(36)	3·2	6	24/½wh	[200]

Description. Evolute, thick whorls; large spines, broad distant ribs, and striae replaced at D *c.* 40 mm by close, not quite regular ribs, slightly curved and rursiradiate, but strongly projected ventrally; whorl section subquadrate, with umbilical edge smooth, rounded, becoming steep; venter broad, tabulate, with prominent keel; last suture only partly visible; aperture broken.

Discussion. The specimen is similar to several species which show change in ornamentation from spines or tubercles to ribs, but *ptycta* has more strongly curved ribs, *spinicostata* has the ribs more confined to the whorl sides, *crassa* has more distant ribs which do not show ventral projection, *euromphalica* shows earlier decline of the tubercles, *regularis* has a relatively narrower venter, and *submarginata* has slightly less well-developed ribs and narrower venter. It is most similar (though smaller) to some specimens of *marginata* figured by Buckman and to some described by him as intermediate between *marginata* and *dominans*.

Buckman (1892, p. 322) recorded *S. marginata* from the '*Concavum*-zone' of Bradford Abbas and other localities in Dorset, but this was later changed to Discites Zone (see also Barker and Torrens 1971, pp. 54–55).

Locality. Top of Concavum Zone or base of Discites Zone; approximately 17 m above base of Shaly Sandstones; lowest exposure in Bearreraig Burn, Trotternish, Isle of Skye.

Euhoploceras (*Euhoploceras*) ?*dominans* (Buckman)

Plate 7, figs. 1–2

1892 *Sonninia dominans* S. Buckman, pp. 322–324, pl. 66; pl. 67, figs. 1–2, ?3–4; pl. 69.
1894 *Sonninia dominans* S. Buckman, pp. 435–437, pl. 94, figs. 1–2; pl. 95, fig. 1; pl. 97, fig. 4.
1923 *Sonninia dominans* Buckman, Fallot and Blanchet, pp. 100–101.
1937 *Sonninia dominans* Buckman, Gillet, p. 53.
1966 *Sonninia* (*Euhoploceras*) *adicra* (Waagen) 'forma dominans', Westermann, p. 310.
1973 *Sonninia* (*Euhoploceras*) *dominans* Buckman, Imlay, pp. 63–64, pls. 11–12.

Material. One large fragment, HMS 15337.

Dimensions.

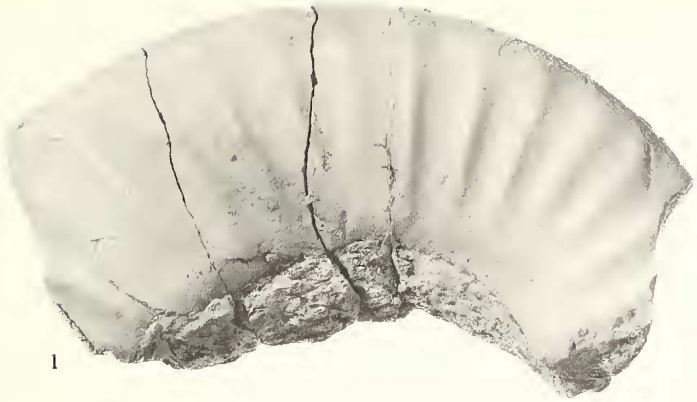
D	Wh	H	Wb	B	W	Ud	U	Vw	V	Vb	Rd	R	Rn	C
c. 150	54·5	36	37·1	25	68	*c.* 62·0	41	15·0	10	40	12·1	8	13/¼wh	[*c.* 150]
P —	43·0	—	32·8	—	76	—	—	12·3	—	38	8·9	—	—	—

EXPLANATION OF PLATE 7

Figs. 1, 2. *Euhoploceras* (*Euhoploceras*) ?*dominans* (Buckman); HMS 15337; top of Concavum Zone or base of Discites Zone; 17 m above base of Shaly Sandstones, lowest exposure in Bearreraig Burn, Trotternish, Skye, ×0·72.

Figs. 3, 4. *Euhoploceras* (*Euhoploceras*) sp. (?cf. *modesta* Buckman); HMS 26403; Discites Zone; 29 m below top of Shaly Sandstones, Bearreraig Burn, Trotternish, Skye, ×0·35.

Figs. 5, 6. *Euhoploceras* (*Euhoploceras*) sp. (?cf. *costatum* Buckman); HMS 26402; Discites Zone; 26 m below top of Shaly Sandstones, Bearreraig Burn, Trotternish, Skye, ×0·33.

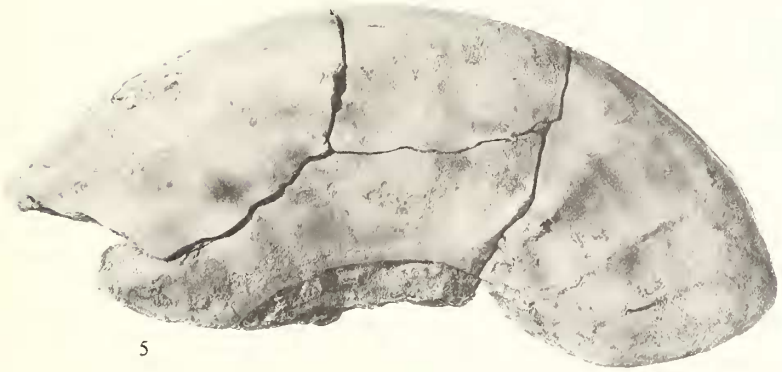


1

2

3

4



5

6

MORTON, Scottish Bajocian ammonites

Description. Evolute, mainly body chamber; regular moderately widely spaced straight ribs approximately rectiradiate with slight ventral projection, confined to whorl sides; umbilical edge smooth and rounded; venter broad, smooth, tabulate (almost bisulcate), with keel; last suture partly visible.

Discussion. The ribbing on this specimen is more regular and relatively more widely spaced (R = 8 cf. 6) than in *marginata* described above. Of other similarly ribbed species *dominata* has more closely spaced ribs and *crassa* has broader whorl cross-section. The specimen is most similar to *dominans*, which Buckman (1892, pp. 323–324) recorded from the '*Concavum*-zone' of Bradford Abbas and other localities in Dorset. This may be either Concavum Zone or Discites Zone (Barker and Torrens 1971, pp. 54–55) (see also Imlay 1973, p. 5, etc.).

Locality. Top of Concavum Zone or base of Discites Zone; approximately 17 m above base of Shaly Sandstones; lowest exposure in Bearreraig Burn, Trotternish, Isle of Skye.

Euhoploceras (*Euhoploceras*) spp.

Plate 7, figs. 3–6

Material. Four very large fragments, HMS 15336, HMS 26401, HMS 26402, HMS 26403.

Dimensions.

	D	Wh	H	Wb	B	W	Ud	U	Vw	V
HMS 15336	*c.* 340·0	120·0	35	81·4	24	68	*c.* 145·0	43	(30·6)	(9)
	Vb	Rd	R	Rn	C	SLo	SLi	SLl	S	
	(38)	48·1	14	*c.* 8/½wh	—	—	—	—	—	
	D	Wh	H	Wb	B	W	Ud	U	Vw	V
HMS 26401	*c.* 305·0	126·0*	41*	—	—	—	*c.* 98·0	32	*c.* 27·5	9
	Vb	Rd	R	Rn	C	SLo	SLi	SLl	S	
	—	—	—	—	[130]	27·0	4·1	38·1	60	
	D	Wh	H	Wb	B	W	Ud	U	Vw	V
HMS 26402	*c.* 300·0	102·0	34	*c.* 68·0	23	67	*c.* 120·0	40	24·0	8
	Vb	Rd	R	Rn	C	SLo	SLi	SLl	S	
	35	29·2	10	*c.* 7/¼wh	[145]	—	—	—	—	
	D	Wh	H	Wb	B	W	Ud	U	Vw	V
HMS 26403	*c.* 310·0	*c.* 105·0*	34*	*c.* 53·0*	17*	50*	*c.* 128·0	41	23·7	8
	Vb	Rd	R	Rn	C	SLo	SLi	SLl	S	
	45	*c.* 35·0	11	*c.* 6/¼wh	[160]	—	—	—	—	
	D	Wh	H	Wb	B	W	Ud	U	Vw	V
	—	84·0	—	50·0	—	60	—	—	22·4	—
	Vb	Rd	R	Rn	C	SLo	SLi	SLl	S	
	45	—	—	—	—	—	—	—	—	

Description. Mostly body chamber; evolute with more or less subquadrate whorls; HMS 26402 has broad irregularly developed straight ribs, slightly rursiradiate, fading on to umbilical shoulder and upper part of whorl sides; HMS 15336 has very broad more distant blunt ribs than HMS 26402 (R = 14 cf. 10); there are a few broad undulations on HMS 26401 and HMS 26403, which is also striate; venters broad,

tabulate or subtabulate and almost bisulcate in HMS 26402, with a broad low keel; HMS 26401 shows complex suture with long lateral lobe.

Discussion. HMS 15336 is similar to typical *adicrum* (Waagen), while HMS 26402 resembles *costatum* (Buckman) and related species. HMS 26401 and HMS 26403 have more quadrate whorl section than *parvicostatum* and *nudum* (Buckman), more prominent keel than *contusum*, *simplex*, and *substriatum* (Buckman), but are most similar to *modesta* (Buckman). The specimens are not well enough preserved for definite identification. According to Westermann (1966, p. 289), *Euhoploceras* (*E.*) *adicra* (Waagen) and the related species referred to above are mainly from the Discites Zone. The exact range of most species has not been established (see also Imlay 1973).

Localities. (*a*) Discites Zone; Shaly Sandstones—(i) HMS 26402 from 26 m below the top, (ii) HMS 26401 from 27 m below the top, (iii) HMS 26403 from 29 m below the top—all in the Bearreraig Burn section below the main waterfall. (*b*) Ovalis Zone; top 2–3 m of the Shaly Sandstones; foot of high cliff 300 m north of Holm. Both localities are in Trotternish, Isle of Skye.

Subgenus EUHOPLOCERAS (FISSILOBICERAS) Buckman, 1919

Type species. Ammonites fissilobatus Waagen, 1867, original designation by Buckman (1919, p. 15).

Discussion. Fissilobiceras was regarded as a subgenus of *Sonninia* by Westermann and Riccardi (1972, p. 59) who commented on the differences between it and *Shirbuirnia* (cf. Arkell 1957) and noted the possibility of derivation from the hammatoceratid *Eudmetoceras* (*Euaptetoceras*) *amplectens* (Buckman).

Euhoploceras (*Fissilobiceras*) *fissilobatum* (Waagen)

Plate 6, fig. 1; Plate 8, figs. 1–3

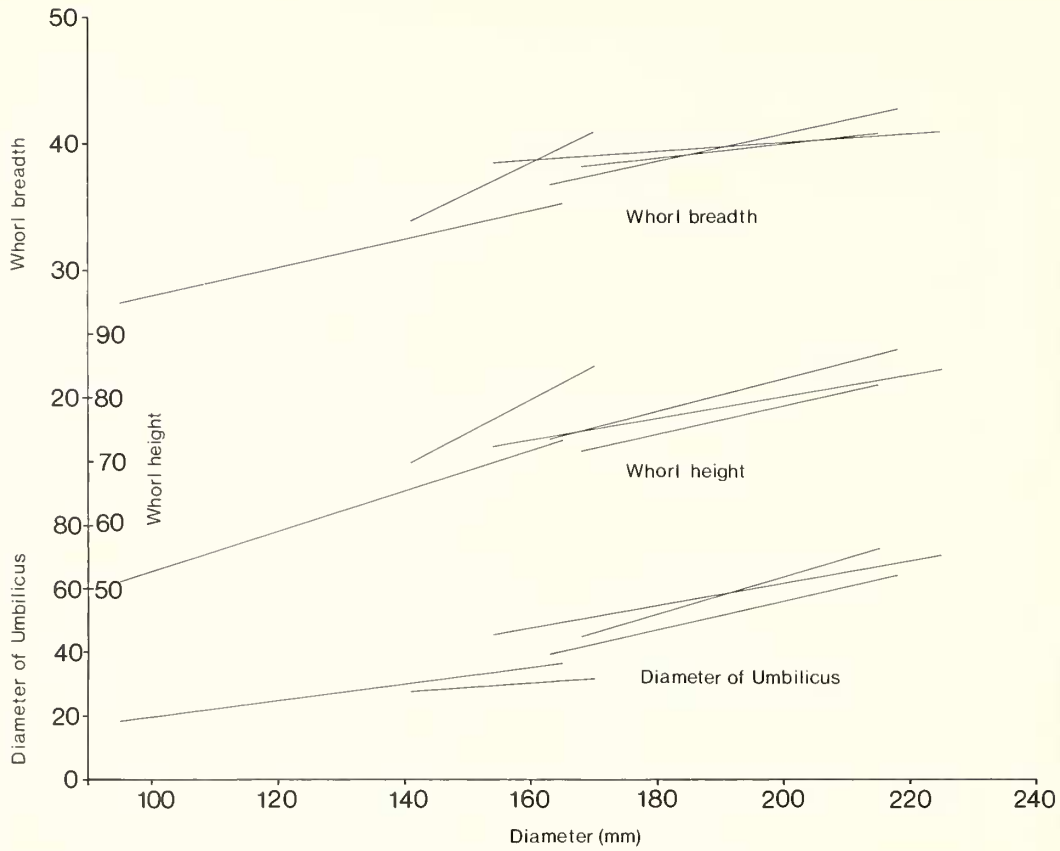
1867 *Ammonites fissilobatus* Waagen, p. 599, pl. 27, fig. 1*a*, *b*.
1886 *Ammonites fissilobatus* Quenstedt, pp. 501–502, pl. 63, fig. 1.
1920 *Fissilobiceras fissilobatum* Waagen sp., Buckman, pl. 181A, B.
1935 *Sonninia fissilobata* Waagen, Dorn, pp. 56–57, pl. 13, fig. 1; pl. 15, fig. 4; pl. 5, figs. 8–9.
1958 *Sonninia fissilobata* (Waagen), Oechsle, pp. 96–98, pl. 11, figs. 11–12; pl. 12, figs. 7–8; pl. 19, fig. 4.
1972 *Sonninia* (*Fissilobiceras*) *fissilobata* (Waagen), Westermann and Riccardi, p. 59, text-fig. 22.

Material. Eight large specimens and two fragments, HMS 15343/1–4, HMS 26397, HMS 26399/1–3, HMS 26400/1–2.

Dimensions. For the full list of dimensions see deposited data.

Mean and standard deviation for characters which show little variation with growth are (twelve observations): H = 43·4 (6·0); U = 26·8 (5·6); V = 8·4 (1·2); Vb = 36·9 (3·9); C = 217·5 (two specimens only); S = 67·6 (10·1). Maximum measured diameter is *c.* 370 mm in HMS 26400/1, *c.* 225 mm in HMS 15343/1.

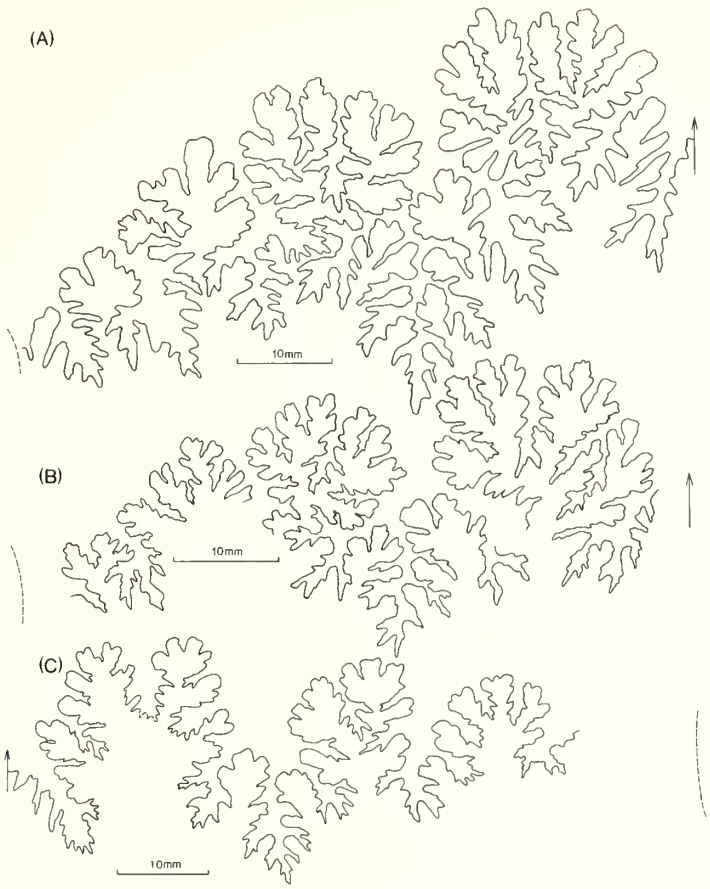
Description. Moderately involute becoming more evolute (see text-fig. 1); innermost whorls ribbed, but ribs become irregular and fade by D approx. 40 mm, or earlier; intermediate and outer whorls smooth or striate; radial line very slightly curved but strongly projected; whorl cross-section elongate sub-oval, maximum thickness just below mid-whorl; umbilical edge rounded, steep but not vertical; venter broad, obtusely fastigate with blunt low keel; sutures complex with long deeply divided



TEXT-FIG. 1. Umbilical diameter, whorl height, and whorl breadth plotted against diameter for specimens of *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen) from Skye.

lateral lobe and umbilical lobes slightly retracted (text-fig. 2A, B); aperture curved with large ventral projection; body chamber, just under two-thirds of a whorl, shows eccentric coiling with widening umbilicus (see text-fig. 1). Specimen HMS 26397 has the bivalved aptychus preserved inside the body chamber (Morton 1973 and Pl. 8, figs. 2–3).

Discussion. The specimens are smoother, more involute, and have a more distinctly fastigate venter, and a more complex suture than the great majority of species of *Euhoploceras*. They are similar to *nuda* Buckman, but the maximum whorl thickness in this species is lower on the whorl sides giving a more triangular whorl cross-section, while *stephani* Buckman also has a different whorl shape and a simpler suture line. They are similar to *ovalis* Quenstedt but the cross-sections of this species figured by Quenstedt (1886) and Oechsle (1958) show a more rounded venter even on the inner whorls, and a less complex suture with shorter lateral lobe. The whorl cross-section of the Skye specimens, especially the shape of the venter, and the complex suture, especially the long lateral lobe, are most like *fissilobatus* Waagen, although most



TEXT-FIG. 2. Suture lines of A, *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen), HMS 15343/3 at Wh 69·3 mm (×1·3); B, *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen), HMS 15343/4 at Wh 60·9 mm (×1·4); C, *Shirbuirnia trigonalis* Buckman, HMS 15342/1 at Wh 75·2 mm (×1·2).

would be larger if complete. At first sight the Skye specimens seem more evolute, but this is because the figured specimens mostly lack a body chamber. The specimen of *fissilobatum* figured by Buckman (1920, pl. 131A) has the trace of the umbilical seam for a further two-thirds of a whorl and this shows that the umbilicus widens in the same way as in the Skye specimens. A minor difference is that the ribbing on the inner whorls of the Skye specimens fades at a slightly earlier stage than on figured specimens of *fissilobatum* from Germany.

In Germany the species *fissilobatum* is recorded from the Sowerbyi Zone by Waagen (1867), the Sowerbyi–Bank by Oechsle (1958, p. 124), and the Brauner Jura γ by Quenstedt (1886, p. 501). Dorn (1935, p. 120) records it as from 'mittleres Gamma', which Westermann (1967, table 6) shows as being in the Sowerbyi Zone, above the Discites Subzone and below the Sauzei Zone. Buckman (1920) records the species from the lower part of the Sandford Lane fossil bed, the '*Shirbuirnia* hemera', of Dorset.

Localities. Ovalis Zone; top 2–3 m of Shaly Sandstones: (*a*) most specimens are from the foot of the high cliff 300 m north of Holm; (*b*) HMS 26400/1–2 are from the foot of the main waterfall in the Bearreraig Burn; both localities in Trotternish, Isle of Skye.

Genus SHIRBUIRNIA Buckman, 1910

Type species. Shirbuirnia trigonalis Buckman, 1910, subsequent designation by Arkell (1954, p. 561).

Discussion. Shirbuirnia has been discussed recently by Westermann and Riccardi (1972, p. 59) who classified it as a subgenus of *Sonninia*, disagreeing with the relationship between *Shirbuirnia* and *Fissilobiceras* suggested by Arkell (1957, pp. L268, 270).

Shirbuirnia trigonalis Buckman

Plate 6, fig. 4

1910 *Shirbuirnia trigonalis* Buckman, p. 92, pl. 10, figs. 2–3.
1924 *Shirbuirnia trigonalis* Buckman, pl. 517A, B.

Material. One large specimen, HMS 15342/1.

Dimensions.

	D	Wh	H	Wb	B	W	Ud	U	
A	*c.* 266·0	*c.* 86·0	32	*c.* 58·0	22	67	103·4	39	
	Rd	R	Rn		C	SLo	SLi	SLl	S
	c. 42·5	16	*c.* 6/½wh		210	—	—	—	—
	D	Wh	H	Wb	B	W	Ud	U	
	253·0	83·1	33	*c.* 52·8	21	64	95·3	38	
	Rd	R	Rn		C	SLo	SLi	SLl	S
	—	—	—		—	—	—	—	—
	D	Wh	H	Wb	B	W	Ud	U	
	c. 198·0	75·9	38	*c.* 51·5	26	68	66·9	34	
	Rd	R	Rn		C	SLo	SLi	SLl	S
	—	—	—		—	—	—	—	—
	D	Wh	H	Wb	B	W	Ud	U	
P	*c.* 180·0	75·2	42	*c.* 47·2	26	63	56·8	32	
	Rd	R	Rn		C	SLo	SLi	SLl	S
	—	—	—		—	25·2	7·4	29·7	60

Description. Increasingly evolute in final whorl; maximum breadth low on whorl sides; inner whorls with broad irregular ribbing; intermediate whorls smooth; outer whorl has very broad low undulations on lower half of whorl sides; whorl section subtrigonal, umbilical edge rounded becoming vertical into deep umbilicus; venter

---

EXPLANATION OF PLATE 8

Figs. 1–3. *Euhoploceras* (*Fissilobiceras*) *fissilobatum* (Waagen); HMS 26397; Ovalis Zone; top 2–3 m of Shaly Sandstones, foot of high cliff 300 m north of Holm, Trotternish, Skye. 1, side view, ×0·50. 2, 3, aptychus and ventral view, stereopair (separation 65 mm), ×1.

1

2

3

MORTON, Scottish Bajocian ammonites

fastigate, not distinct from whorl sides, with low blunt keel; suture (text-fig. 2c) less complex than typical of large sonniniids; body chamber over half a whorl in length.

Discussion. This specimen is more evolute, has a different whorl shape and a simpler suture than the specimens of *fissilobatum* (Waagen) with which it occurs. The subtrigonal whorl shape and relatively simple suture are characteristic of *Shirbuirnia*. Of four species described, *stephani* (Buckman, 1882) and *fastigata* Buckman, 1924 are more involute and have sharper venter; *pseudotrigonalis* Maubeuge, 1951 is more involute but otherwise similar. The specimen is most similar to *trigonalis* Buckman, 1910, although this is slightly more involute and larger (D = 328 mm cf. c266 mm). *Sh. trigonalis* is listed by Buckman (1924, pl. 517; 1930, p. 36) as coming from the *Shirbuirnia* hemera of Sandford Lane, Dorset.

Locality. Ovalis Zone; top 2–3 m of the Shaly Sandstones; foot of high cliff 300 m north of Holm, Trotternish, Skye.

Genus WITCHELLIA Buckman, 1889

Type species. Ammonites laeviusculus J. de C. Sowerby, original designation by Buckman (1889, p. 82).

Includes. Zugophorites Buckman, 1923, *Gelasinites* Buckman, 1925, *Rubrileiites* Buckman, 1926, *Zugella* Buckman, 1927, ?*Dundryites* and *Anolkoleiites* Buckman, 1926.

Witchellia aff. *rubra* (Buckman)

Plate 9, figs. 1–34

aff. 1926 *Rubrileiites ruber* S. Buckman, pl. 642.
aff. 1939 *Sonninia stephani ruber* (Buckman), Hiltermann, p. 180, pl. 12, fig. 10; pl. 13, figs. 8–9.

Material. Fifty-four specimens, HMS 15344/1–2, HMS 15346/1–3, HMS 26404/1–45, HMS 26405/1–3, HMS 26406, GSE 2968.

Dimensions. For the full list of dimensions see deposited data.

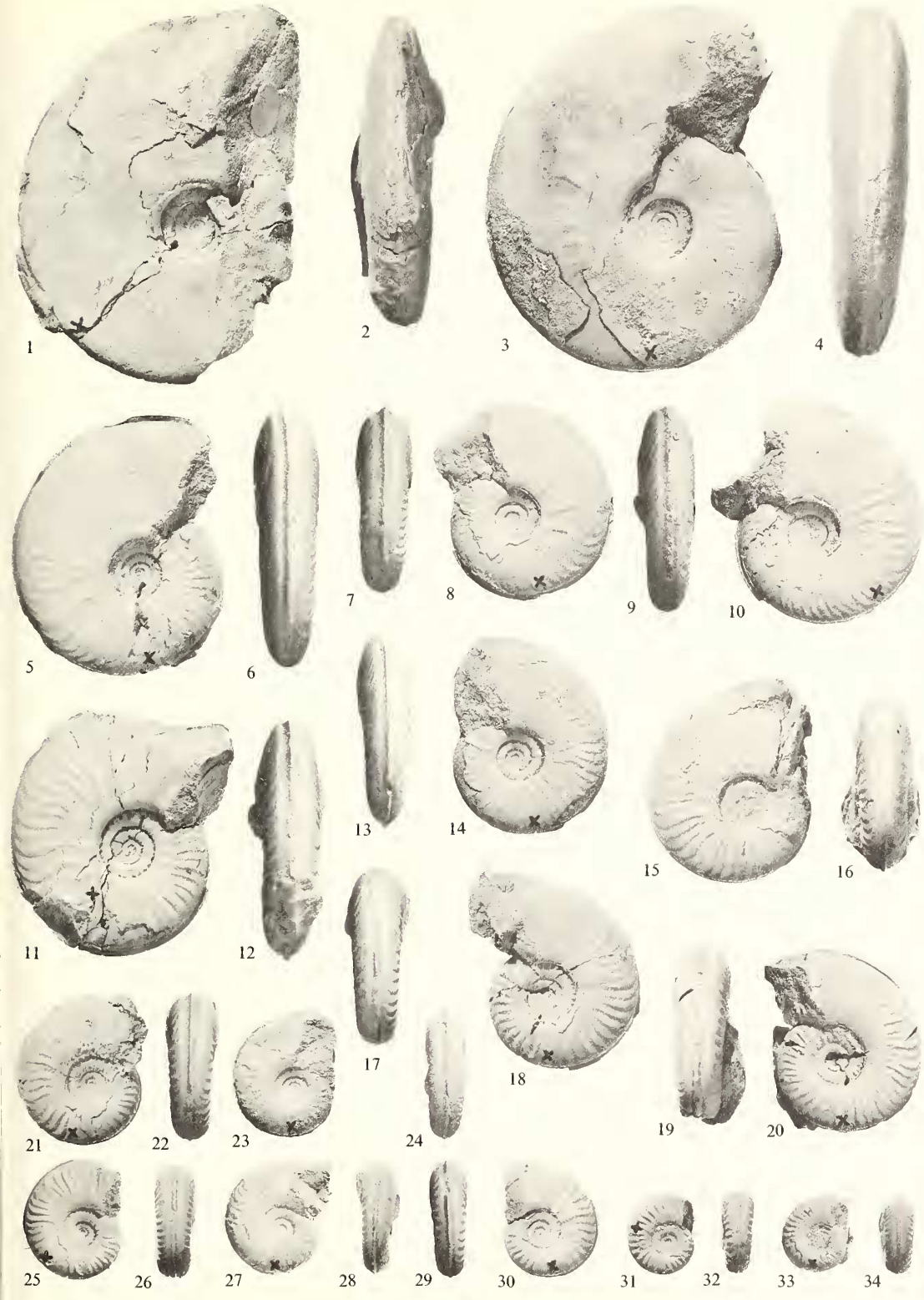
Mean and standard deviation for characters which show little variation with growth are (140 observations): H = 43·4 (3·4); U = 29·8 (4·6); V = 12·6 (3·6); Vb = 40·2 (4·8); ^{s}R = 6·6 (1·5), but ribs fade on some specimens; ^{s}Rn = 21·2/½wh (3·7); C = 208·6 (9·0); S = 35·0 (6·5). Maximum measured diameter is 62·0 mm in HMS 15346/1. Regression equations (see also text-fig. 3) are:

$$Wh = 0{\cdot}50\ D - 1{\cdot}18\ [0{\cdot}44]$$
$$Wb = 0{\cdot}19\ D + 2{\cdot}22\ [0{\cdot}28]$$
$$Ud = 0{\cdot}18\ D + 2{\cdot}25\ [0{\cdot}68]$$

EXPLANATION OF PLATE 9

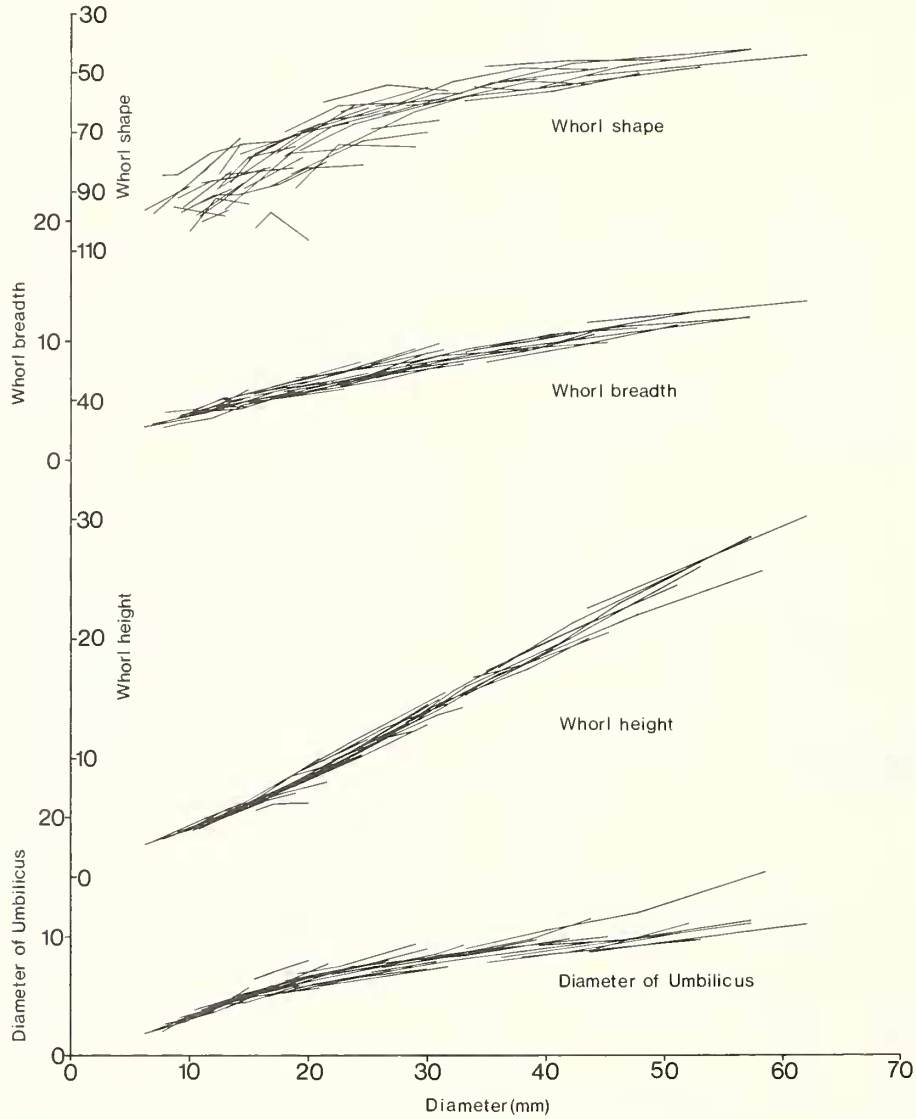
All figures natural size.

Figs. 1–34. *Witchellia* aff. *rubra* (Buckman); Laeviuscula Zone; approximately 18 m below top of Massive Sandstones, ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye. 1, 2, HMS 15346/1; 3, 4, HMS 26404/2; 5, 6, HMS 26404/5; 7, 8, HMS 26404/6; 9, 10, HMS 26404/7; 11, 12, HMS 15344/1; 13, 14, HMS 26404/9; 15, 16, HMS 26404/8; 17, 18, HMS 26404/14; 19, 20, HMS 26404/18; 21, 22, GSE 2968; 23, 24, HMS 26404/21; 25, 26, HMS 26404/22; 27, 28, HMS 26404/23; 29, 30, HMS 26404/24; 31, 32, HMS 26404/37; 33, 34, HMS 26404/38.



MORTON, Scottish Bajocian ammonites

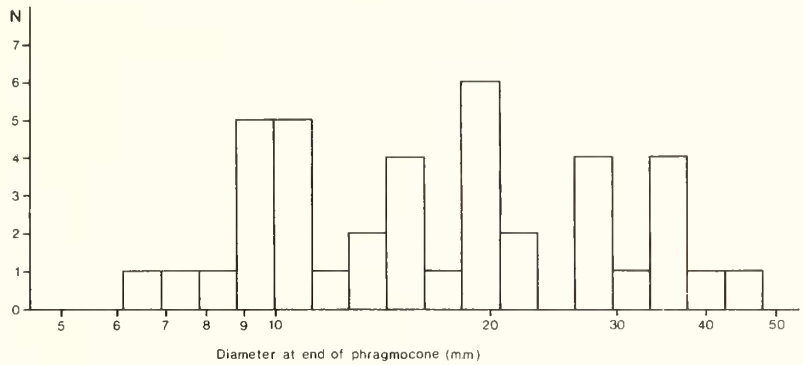
Description. Involute compressed (see text-fig. 3); protoconch bulbous and very broad; first whorls broader than high, smooth then developing broad faint undulations, with rounded venter lacking keel; the broad undulations develop gradually into distinct primary ribs which branch near umbilical shoulder into more prominent secondary ribs; a keel and flattened venter developed (by D 3·5 mm on HMS 26404/27); on outer whorls whorl height greater than breadth, venter more defined, tabulate or even bisulcate with prominent keel; ribbing more pronounced and closer, curved and projected ventrally (sometimes more strongly developed on outer half of whorl sides),



TEXT-FIG. 3. Umbilical diameter, whorl height, whorl breadth, and whorl shape plotted against diameter for specimens of *Witchellia* aff. *rubra* (Buckman) from Skye.

then fainter, many specimens passing from costate to striate, others strongly ribbed at the same diameter; umbilical edge rounded but sharper on outer whorls of larger specimens, with umbilical face vertical in some; aperture curved; body chambers approximately five-eighths of a whorl; few specimens show evidence of maturity; sutures not complex, lateral lobe broad open showing trifid structure (text-fig. 5A, B).

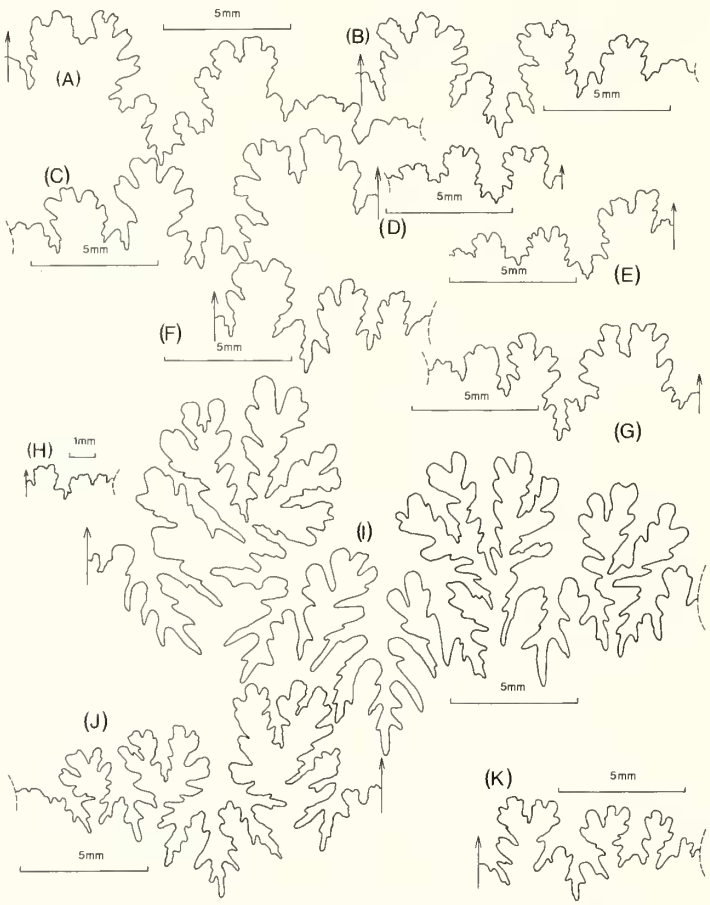
Discussion. The specimens show continuous variation between extremes such as HMS 15346/1 (smooth) and HMS 15344/1 (ribbed). A size-frequency distribution (diameter at end of phragmocone) suggests (text-fig. 4) that there may be three or



TEXT-FIG. 4. Size-frequency distribution (using diameter at end of phragmocone) of specimens of *Witchellia* aff. *rubra* (Buckman) from the Laeviuscula Zone, ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye.

four groups, with thirteen specimens having diameter 6–11 mm at the end of the phragmocone (Pl. 9, figs. 31–34), seven specimens between 12 mm and 15 mm (Pl. 9, figs. 23–30), nine specimens between 17 mm and 22 mm (Pl. 9, figs. 7–8, 13–14, 17–20), and eleven specimens above 25 mm (Pl. 9, figs. 1–6, 9–12). Of the measured specimens five from loose blocks (e.g. Pl. 9, figs. 21–22) and two lacking body chamber (e.g. Pl. 9, figs. 15–16) are excluded from the above figures. In the absence of evidence of maturity it must be assumed that the majority of the specimens were juveniles, and it is possible that the different size groups represent successive generations. Some of the larger specimens may be adults, but the maximum size reached in the Skye population (62 mm in HMS 15346/1) is less than that of comparable *Witchellia* specimens (especially *rubra*) from Dorset (107 mm in Buckman 1926, pl. 642), and Germany (111 mm in Hiltermann 1939, pl. 12, fig. 10) but may be comparable with some of the specimens from northern Germany figured by Hiltermann (1939). Similar variation was described in *Witchellia* from Alaska by Westermann (1969, pp. 116–126) who also concluded that only one species was represented, and suggested (pp. 108–116) that many north-west European species were variants of one species. The Skye population is more homogeneous, and accuracy in taxonomic labelling would be better served by using the best fit specific name. Of described species (Buckman's unless otherwise stated): *actinophora*, *falcata*, *glauca*, *platymorpha*, *sutneri* (Branco), and *crassifalcata* Dorn are all too strongly ribbed and/or too evolute; *spinifera* and *laeviuscula* (Sowerby) have similar outer whorls but spinous inner whorls (the latter

according to Westermann 1969*a*, text-fig. 35, p. 111); *gelasina* is too evolute and has too thick whorls; *helvetica* Maubeuge is not easily recognizable; *sayni* Haug is similar to the smaller specimens. The best fit, showing ribbing on the inner whorls, fading on the outer whorl, is *rubra*. The holotype of *rubra* (GSM 47839) is larger than any of the Skye specimens (D = 106·4 mm cf. maximum of 62·0 mm), and has higher whorls (H = 47), narrower umbilicus (U = 21), and narrower venter (V = 9) than the



TEXT-FIG. 5. Suture lines (all ×3·4) of A, *Witchellia* aff. *rubra* (Buckman), HMS 15346/2 at Wh 16·1 mm; B, *Witchellia* aff. *rubra* (Buckman), HMS 26404/8 at Wh 13·8 mm; C, *Witchellia* aff. *romanoides* (Douvillé), HMS 26408 at Wh 13·6 mm; D, *Pelekodites zurcheri* (Douvillé), HMS 26409/1 at Wh 6·0 mm; E, *Pelekodites zurcheri* (Douvillé), HMS 26410/1 at Wh 7·9 mm; F, *Pelekodites macer* (Buckman), HMS 15340/14 at Wh 7·6 mm; G, *Pelekodites macer* (Buckman), HMS 26412/14 at Wh 8·1 mm; H, *Pelekodites minimus* (Hiltermann), HMS 26413/2 at Wh 3·2 mm; I, *Sonninia* (*Sonninia*) cf. *propinquans* (Bayle), GSE 3060 at Wh 21·2 mm; J, *Sonninia* (*Sonninia*) *corrugata* (Sowerby), HMS 15345/1 at Wh 13·0 mm; K, *Sonninia* (*Sonninia*) *corrugata* (Sowerby), HMS 15345/2 at Wh 8·2 mm.

means of the Skye population, but these values are within the ranges of variation. The ribbing and suture (S = 34) are similar. It differs mainly in having a slightly lower, less sharp keel, and less distinct edges to the venter. The holotype is therefore towards one end of the range of variation of the Skye population, but the differences may not be significant. No topotype population data are available so an open (aff.) determination is used here. If Westermann is correct *rubra* would be a junior synonym of *Witchellia laeviuscula* (Sowerby), but the European species of *Witchellia* come from more than one horizon and from several localities, so cannot be regarded as a single population.

According to Buckman (1926) the holotype of *rubra* comes from Frogden Quarry, Dorset—*ruber* hemera. This would be equivalent to the Laeviuscula Zone in modern terminology. In Germany (Hiltermann 1939) the species comes from bed 20 at Bethel and beds 15–22 at Hellern, both in the 'Sowerbyi Zone' according to Huf (1968, pp. 14–15).

Localities. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstones (cf. Morton 1965, p. 198); ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye. A few specimens (HMS 26405/1–3 and GSE 2968) were found in loose blocks of the Massive Sandstones on the shore just south of Bearreraig, and one specimen (HMS 26406) is from a loose block of the Massive Sandstones at Rudha Sughar, Bearreraig.

Witchellia aff. *laeviuscula* (J. de C. Sowerby)

Plate 10, figs. 1–2

1824 *Ammonites laeviusculus* J. de C. Sowerby, p. 73, pl. 451, figs. 1–2.
1908 *Ammonites laeviusculus* J. de C. Sowerby, Buckman and Secretary, pl. 6, figs. 1–2.
1927 *Witchellia laeviuscula* Sow. sp., Buckman, pl. 745.
1935 *Witchellia laeviuscula* Sow., Dorn, pp. 106–107, pl. 6, fig. 3; pl. 14, fig. 2; pl. 15, fig. 3.
1937 *Witchellia laeviuscula* Sow., Gillet, pp. 61–63, pl. 1, fig. 8; pl. 2, fig. 6; pl. 3, fig. 1.
1969 *Witchellia laeviuscula* (Sowerby), Westermann, p. 111, text-fig. 35.

Material. One specimen, HMS 26407.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	Vw	V	Vb	C
61·6	26·6	43	*c.* 14·4	23	54	14·6	24	*c.* 5·4	9	38	[185]
P42·5	19·2	45	*c.* 11·0	26	57	10·8	25	3·8	9	35	—
27·2	12·4	46	8·3	31	67	*c.* 7·8	29	—	—	—	—

Description. Moderately involute, compressed; inner whorls as broad as high, with broad not very strong primary ribs and occasional tubercles; outer whorls higher than broad; venter smooth, subtabulate, distinct from whorl sides with prominent keel; body chamber with very close faint ribs, slightly stronger on outer part of whorl sides, fasciculate to very broad folds on inner part of whorl sides; radial line slightly flexed, strongly projected ventrally; end of phragmocone broken; aperture largely obscured, body chamber just over half a whorl in length.

Discussion. This specimen is distinguished from other *Witchellia* because at comparable size broad folds are developed as well as the fasciculate fine ribbing. In this and tuberculate inner whorls, it is comparable with the lectotype of *laeviuscula* (Westermann 1969*a*), but the ornamentation is much stronger on the Skye specimen, *falcata* Buckman (1926, pl. 688) lacks the finer ribbing and is more evolute.

Locality. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstone; ledge behind main waterfall in the Bearreraig Burn, Trotternish, Skye.

Witchellia aff. *romanoides* (Douvillé)

Plate 10, figs. 3–4

aff. 1885 *Ludwigia romanoides* Douvillé, pp. 28–30, pl. 3, figs. 3–4.
aff. 1885 *Harpoceras romanoides* Douvillé, Haug, p. 677.
aff. 1893 *Witchellia romanoides* (Douvillé), Haug, p. 309.
?non 1935 *Witchellia romanoides* Douvillé, Dorn, pp. 118–119, pl. 20, fig. 3; pl. 9, fig. 20.

Material. One specimen, HMS 26408.

Dimensions.

	D	Wh	H	Wb	B	W	Ud	U	Vw	V	Vb	sRd	sR	sRn	C
	52·9	22·3	42	—	—	—	16·1	30	—	—	—	—	—	—	[225]
	49·0	20·5	42	11·6	24	57	15·3	31	4·7	10	41	—	—	—	—
	40·6	17·1	42	10·3	25	60	12·9	32	4·4	11	43	—	—	32/½wh	—
P	*c.* 33·3	13·7	41	9·5	29	69	10·9	33	3·7	11	39	*c.* 2·9	9	16/¼wh	—
	—	11·5	—	8·9	—	77	9·4	—	3·2	—	36	—	—	—	—

Description. Moderately involute, compressed; inner whorls strongly ribbed, with faint primary ribs branching near umbilical edge and some prominent tubercles; on outer whorls tubercles disappear and ribbing becomes fainter and closer, body chamber striate with faint irregular ribbing; radial line flexed, strongly projected ventrally; venter smooth, broad, tabulate to slightly bisulcate, with prominent hollow keel; umbilical edge sharply rounded, becoming vertical. Suture (text-fig. 5c) simple with lateral lobe broad and open; last sutures approximated; aperture not preserved but body chamber at least five-eighths of a whorl.

Discussion. This specimen is distinguished from other *Witchellia* because it is more evolute and has tuberculate inner whorls although the style of ribbing is similar. It is similar only to *romanoides* (Douvillé), but differs in having a slightly broader more distinct venter.

Locality. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstones; ledge behind main waterfall in the Bearreraig Burn, Trotternish, Skye.

EXPLANATION OF PLATE 10

All figures natural size.

Figs. 1, 2. *Witchellia* aff. *laeviuscula* (J. de C. Sowerby); HMS 26407.

Figs. 3, 4. *Witchellia* aff. *romanoides* (Douvillé); HMS 26408.

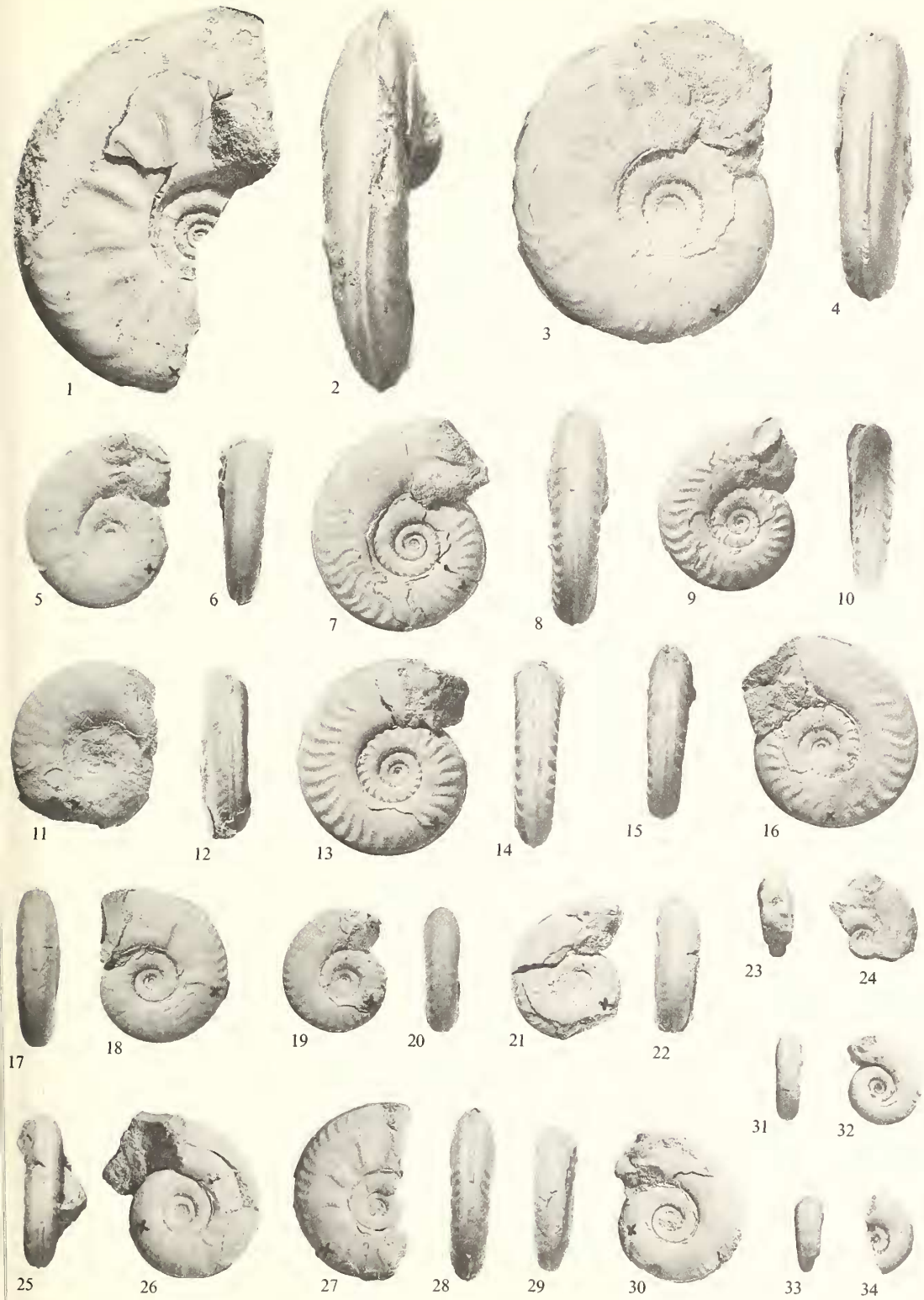
Figs. 5, 6, 11, 12, 17–22, 25–30. *Pelekodites macer* (Buckman); 5, 6, HMS 15350/2; 11, 12, HMS 15350/4; 17, 18, HMS 15350/14; 19, 20, HMS 15350/15; 21, 22, HMS 15351/3; 25, 26, HMS 26412/13; 27, 28, HMS 26412/14; 29, 30, HMS 26412/17.

Figs. 7–10, 13–16. *Pelekodites zurcheri* (Douvillé); 7, 8, HMS 26410/1; 9, 10, HMS 26409/1; 13, 14, HMS 26410/3; 15, 16, HMS 26410/2.

Figs. 23, 24, 31–34. *Pelekodites minimus* (Hiltermann); 23, 24, HMS 26413/3; 31, 32, HMS 26413/2; 33, 34, HMS 26413/1.

Figs. 1–20, 23, 24, 31–34. Laeviuscula Zone; approximately 18 m below top of Massive Sandstones, ledge behind main waterfall in Bearreraig Burn.

Figs. 21, 22, 25–30. Sauzei Zone and Subzone; loose blocks from upper part of Massive Sandstones, Rudha Sughar, Bearreraig. Both localities in Trotternish, Skye.



MORTON, Scottish Bajocian ammonites

Genus PELEKODITES Buckman, 1923

Type species. Pelekodites pelekus Buckman, original designation by Buckman (1923, pl. 399).

Includes. Nannoceras Buckman, 1923, *Maceratites*, *Spatulites* Buckman, 1928.

Pelekodites zurcheri (Douvillé)

Plate 10, figs. 7–10, 13–16

1885 *Sonninia zurcheri* H. Douvillé, pp. 22–24, pl. 1, figs. 5–7.
?1889 *Poecilomorphus macer* S. Buckman, pl. 22, figs. 25–26 only.
1895 *Poecilomorphus moisyi* Brasil, pp. 36–37, pl. 3, figs. 6–7.
?1923 *Pelekodites pelekus* S. Buckman, pl. 399.
?1928 *Maceratites costulatus* S. Buckman, p. 11.
1937 *Sonninia zurcheri* Douvillé, Gillet, p. 48.
1968 *Sonninia* (*Poecilomorphus*) *boweri boweri* Buckman, Huf, pp. 36–44, pl. 1, figs. 6–7; pl. 2, figs. 1–5 (*pars*).

Material. Thirteen specimens, HMS 26409/1–5, HMS 26410/1–10.

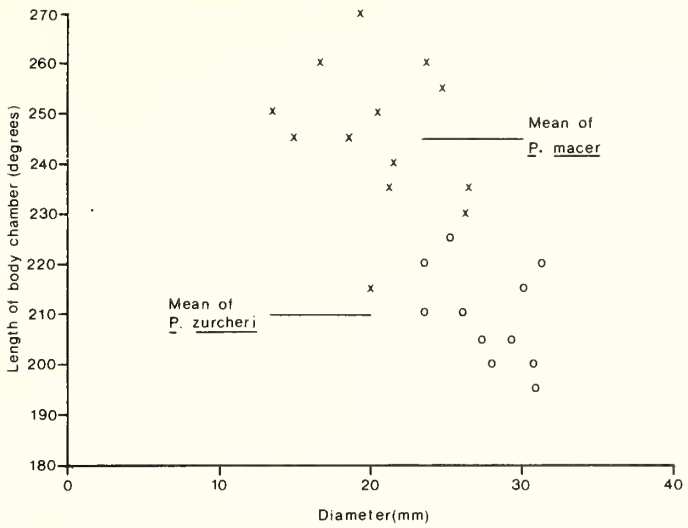
Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (forty-one observations): H = 38·5 (1·8); U = 36·5 (1·9); V = 12·1 (1·7); Vb = 42·0 (5·5); ^{s}R = 8·3 (1·4); ^{s}Rn = 16·5/½wh (2·1); C = 209·6 (9·6); S = 33·6 (3·1). Maximum measured diameter is 31·1 mm in HMS 26410/3; lappets present on HMS 26409/1 at D 26·0 mm, on HMS 26410/1 at D 33·7 mm, and on HMS 26410/2 at D 30·7 mm. Regression equations are:

$$\text{Wh} = 0{\cdot}33\ \text{D} + 1{\cdot}07\ [0{\cdot}12]$$
$$\text{Wb} = 0{\cdot}16\ \text{D} + 2{\cdot}59\ [0{\cdot}17]$$
$$\text{Ud} = 0{\cdot}38\ \text{D} - 0{\cdot}32\ [0{\cdot}17]$$

Description. Moderately evolute, compressed; innermost whorls broader than high, smooth, with broad rounded venter lacking keel; during growth whorl height becomes greater than breadth, a keel develops, and a distinct smooth venter becomes tabulate; broad undulations on whorl sides develop into very short faint primary ribs (which disappear in later whorls) branching near umbilical edge into secondary ribs (still present in the body chamber) slightly stronger on outer part of whorl sides; development of ribbing at variable diameter; radial line flexed, strongly projected ventrally; umbilicus large and shallow with rounded edge; sutures simple with broad open lateral lobe (text-fig. 5D, E); several specimens mature (crowding of the last sutures, increase in relative umbilical diameter) with body chamber usually about seven-twelfths of a whorl and lappets up to 8·5 mm in length.

Discussion. The specimens are adult microconchs and differ from *macer* (see below) in having regularly ribbed shorter body chamber (see text-fig. 6). From specimens of *Witchellia* of similar size they differ in being more evolute, having a squarer whorl section, slightly different style of ribbing, and lappets.

The Skye specimens differ from *macer* Buckman in being more costate, from *aurifer* Buckman in having more regular ribbing, from *spatians* Buckman in being smaller, having more distant ribbing, a less complex suture, and a shorter body chamber, from *hansenbodensis* Maubeuge in having more curved ribbing. They are similar in style of ribbing to several described species, including *zurcheri* Douvillé, 1885, *moisyi* Brasil, 1895, *pelekus* Buckman, 1923, and *costulatus* Buckman, 1928, which probably belong to the one species. The oldest name, *zurcheri*, is used here. Several specimens of



TEXT-FIG. 6. Length of body chamber plotted against diameter for complete specimens only of *Pelekodites macer* (Buckman) (crosses) and *Pelekodites zurcheri* (Douvillé) (circles) from Skye.

Sonninia (*Poecilomorphus*) *boweri boweri* Huf (1968) non Buckman are very similar and almost certainly conspecific.

The specimens described by Buckman and Huf come from the Sowerbyi Zone, as does the lectotype of *zurcheri* (Douvillé 1885, pl. 1, fig. 6, designated by Buckman 1923), while Gillet (1937, p. 48) records the species from the Laeviuscula Zone in Lorraine.

Locality. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstone; ledge behind the main waterfall in the Bearreraig Burn, Trotternish, Skye.

Pelekodites macer (Buckman)

Plate 10, figs. 5–6, 11–12, 17–22, 25–30

1889 *Poecilomorphus macer* S. Buckman, pp. 116–117, pl. 22, figs. 23–24 only.
1895 *Poècilomorphus macer* Buckman, Brasil, p. 36.
1928 *Maceratites macer* S. Buckman, pp. 11–12.

Material. Forty-two specimens, HMS 15350/1–8, 14–16, 20, HMS 15351/1–9, HMS 26411/1–2, HMS 26412/1–19.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (eighty-six observations): H = 40·2 (3·1); U = 33·0 (2·8); V = 13·2 (2·5); Vb = 38·9 (11·4); ^{s}R = 6·8 (1·2); ^{s}Rn = 22·7/½wh (3·5) (^{s}R and ^{s}Rn are based on only a few measurements, most specimens show decline of the ribbing); C = 245·4 (14·6); S = 37·4 (7·9). Maximum measured diameter is 28·0 mm in HMS 15350/3 and HMS 26412/12; lappets present on HMS 15350/2 at D 26·5 mm, HMS 26412/17 at 23·7 mm:

$$Wh = 0{\cdot}39\ D + 0{\cdot}24\ [0{\cdot}23]$$
$$Wb = 0{\cdot}19\ D + 2{\cdot}09\ [0{\cdot}16]$$
$$Ud = 0{\cdot}35\ D - 0{\cdot}26\ [0{\cdot}19]$$

Description. Moderately evolute, compressed; protoconch large and bulbous; innermost whorls broader than high, smooth, with broad rounded venter lacking keel; faint broad undulations develop into variable primary ribs and a keel develops; outer whorls higher than broad with primary ribs branching just above umbilical edge into secondary ribs, but ribbing irregular, sometimes fasciculate and fainter on middle of whorl sides; on outer whorls venter with keel, tabulate or slightly bisulcate; radial line flexed laterally, strongly projected ventrally; umbilicus large and shallow, with umbilical edge rounded not usually steep; sutures simple with broad open lateral lobe (text-fig. 5F, G); in some specimens crowding of sutures, relative widening of umbilicus and spatulate lappets up to 8·8 mm long (Pl. 9, figs. 29–30); body chamber about two-thirds of a whorl; HMS 26412/12 pathological, with keel and venter displaced to one side for at least the outer whorl which is visible.

Discussion. The specimens differ from *zurcheri* in having less regular ribbing and longer body chambers (see text-fig. 6), and from other specimens of similar size from the same localities in being more evolute, having more quadrate whorl section, a different style of ribbing, and lappets. Of described species of *Pelekodites*, Buckman's species *pelekus*, *nannomorphum*, *spatians*, *aurifer*, and *costulatus* are more strongly and more regularly ribbed, but *macer* is very similar. According to Buckman (1928, p. 12) the holotype of *macer* comes from the 'marl with green grains', Frogden Quarry, Dorset (Sonninian, *Witchellia* hemera), that is from the Laeviuscula Zone. The similar specimens described by Huf (1968) as *Sonninia* (*Poecilomorphus*) *boweri boweri* (Buckman) or *S.* (*P.*) *boweri buckmani* (Haug) are from the Sowerbyi and Sauzei Zones.

Localities. (*a*) HMS 15350/1–8, 14–16, 20, HMS 26411/1–2 are from the Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstone; ledge behind main waterfall in the Bearreraig Burn; (*b*) HMS 15351/1–9, HMS 26412/1–19 are from the Sauzei Zone and Subzone; loose blocks from the uppermost part of the Massive Sandstone; Rudha Sughar. Both localities are at Bearreraig, Trotternish, Skye.

Pelekodites minimus (Hiltermann)

Plate 10, figs. 23–24, 31–34

1939 *Sonninia deltafalcata minima* Hiltermann, pp. 174–175, pl. 12, figs. 4, 6.
1968 *Sonninia* (*Poecilomorphus*) *boweri minima* (Hiltermann), Huf, pp. 50–53, pl. 4, figs. 4–6.

Material. Three specimens, HMS 26413/1–3.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (ten observations): H = 37·5 (3·3); U = 35·5 (4·6); V = 15·0 (4·3); Vb = 45·0 (7·3); C = 235; S = 18 (on HMS 26413/2 only). Diameters at apertures are 12·5 mm, 13·6 mm, and 17·3 mm; lappets present on HMS 26413/2 at D 13·6 mm and on HMS 26413/3 at 17·3 mm. Regression equations are:

$$\text{Wh} = 0{\cdot}33\ \text{D} + 0{\cdot}41\ [0{\cdot}11]$$
$$\text{Wb} = 0{\cdot}15\ \text{D} + 2{\cdot}13\ [0{\cdot}18]$$
$$\text{Ud} = 0{\cdot}41\ \text{D} - 0{\cdot}50\ [0{\cdot}05]$$

Description. Small, evolute; protoconch large bulbous, and smooth; first whorls smooth, broader than high, with broad smooth venter lacking keel; by second whorl broad blunt undulations on whorl sides; by D 4·0 mm a faint keel bordered by two

shallow sulci appears, and whorls become higher than broad; on outer whorls and body chamber faint irregular fasciculate ribbing strongly curved backwards on upper part of whorl curving forwards on to venter; umbilical edge rounded not steep; there is slight increase in relative size of umbilicus in HMS 26413/1 and 2 while HMS 26413/2 and 3 have lappets, up to 3·7 mm in length; sutures simple (text-fig. 5H); in HMS 26413/2 the last two sutures are closer; body chamber about two-thirds of a whorl.

Discussion. The specimens are adult microconchs, reaching maturity at a much smaller size than others from the same bed—the end of the phragmocone being at diameter 8·6 mm in HMS 26413/2 and approximately 10 mm in HMS 26413/3. They are similar to specimens from Bethel, northern Germany, figured by Hiltermann (1939) and Huf (1968). This species (*minima*) is now transferred to *Pelekodites*. According to Huf (1968, p. 53) *P. minimus* occurs in the Sowerbyi Zone of northern Germany.

Locality. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstone; ledge behind main waterfall in the Bearreraig Burn, Trotternish, Skye.

Genus SONNINIA Bayle, 1879

Subgenus SONNINIA (SONNINIA) Bayle, 1879

Type species. Waagenia propinquans Bayle, 1878, original designation by Bayle in Douvillé's presentation of the Atlas (see *Bull. Soc. géol. Fr.* sér. 3, vol. 7, p. 92).

Includes. Sonninites Buckman, 1925 (not *Sonnites* as given by Arkell 1957, p. L267).

Sonninia (*Sonninia*) cf. *sowerbyi* (J. Sowerby)

Plate 11, figs. 3, 10

cf. 1818 *Ammonites Sowerbyi* Miller (MS.), J. Sowerby, p. 235, pl. 213.
cf. 1908 *Ammonites Sowerbii* J. Sowerby, Buckman and Secretary, text-fig. with explanation of pl. 3.

Material. One medium-sized specimen, HMS 26414.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	sRn	Td	T	Tn	Tc	C
c. 89·0	31·2	35	—	—	—	34·7	39	15/¼wh	var.	—	6/¼wh	5	[180]
P 73·2	25·1	34	16·0	22	64	28·4	39	—	var.	—	—	—	—
52·8	21·5	41	*c.* 13·3	25	62	18·2	34	34/½wh	6·7	13	10/½wh	—	—
40·5	15·6	39	15·5	38	99	13·7	34	19/¼wh	7·0	17	8/½wh	—	—

Description. Evolute, compressed; inner whorls with moderately strong distant ribbing and large tubercles, approximately six per whorl; on intermediate whorls ribbing stronger and tubercles larger and closer (approximately fourteen per whorl); last part of phragmocone missing; on body chamber more distant, less regularly developed tubercles remain with more pronounced curved ribbing branching at tubercles, and strongly projected ventrally; on intermediate and outer whorls whorl breadth (between tubercles) less than height; umbilicus large, shallow with rounded indistinct edge; venter acutely fastigate, also not distinct, with high prominent keel; body chamber incomplete at 180° (with trace of umbilical seam for a further 45°).

Discussion. This specimen differs from others from the same locality and from most described species in having the tubercles typical of the inner whorls still present on the body chamber along with well-developing ribbing. The type and distribution of tubercles on the body chamber are not comparable with those found on specimens of *Sonninia* (*Papilliceras*), especially in being less regular. The end of the phragmocone and of the body chamber are missing on the specimen so that it is impossible to establish whether it was mature. It cannot be matched exactly with any complete figured species. The inner whorls are very similar to the holotype of *sowerbyi* which lacks the outer whorls, so it is impossible to be certain of the exact nature of this species. Westermann and Riccardi (1972, p. 47) suggest that it may be the inner whorls of a *Sonninia* (*Papilliceras*). In the past *Sonninia sowerbyi* has been recorded from most parts of the Lower Bajocian, but it seems likely that the holotype and really typical *S. sowerbyi* as distinct from *Euhoploceras* spp. come from the Sauzei Zone.

Locality. Sauzei Zone and Subzone; loose block from the upper part of the Massive Sandstones; Rudha Sughar, Bearreraig, Trotternish, Skye.

Sonninia (*Sonninia*) cf. *propinquans* (Bayle)

Plate 12, figs. 5, 8; Plate 14, figs. 1–6

cf. 1878 *Waagenia propinquans* Bayle, pl. 84, figs. 1–6(?)
cf. 1922 *Sonninia propinquans* Bayle sp., Buckman, pl. 298.

Material. Eleven medium-sized to small specimens, HMS 15339, HMS 26415, HMS 26416, GSE 2972–2974, GSE 2976–2978, GSE 3020, GSE 3060.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (twenty observations): H = 41·6 (2·9); U = 34·0 (3·2); ^{s}Rn = 27·7/½wh (3·7); T = 25·6 (5·9); S = 74·6 (7·6). Maximum measured diameter is 73·1 mm in GSE 3060. Regression equations are:

$$Wh = 0{\cdot}39\,D + 1{\cdot}08\ [0{\cdot}99]$$
$$Wb = 0{\cdot}18\,D + 4{\cdot}11\ [0{\cdot}70]$$
$$Ud = 0{\cdot}34\,D - 0{\cdot}06\ [1{\cdot}37]$$

Description. Moderately evolute and compressed; innermost whorls smooth or ribbed, but by D 10 mm large distant blunt tubercles dominant; on intermediate whorls tubercles larger, sharper, and more regular, with more or less irregular strong

---

EXPLANATION OF PLATE 11

All figures natural size.

Figs. 1, 2. *Sonninia* (*Papilliceras*) *arenata* (Quenstedt); HMS 15341/1.
Figs. 3, 10. *Sonninia* (*Sonninia*) cf. *sowerbyi* (Sowerby); HMS 26414.
Figs. 4–9. *Sonninia* (*Sonninia*) *corrugata* (Sowerby); 4, 5, HMS 15345/3; 6, 7, HMS 26417/16; 8, 9, HMS 26417/20.

All specimens (except figs. 4, 5) from Sauzei Zone and Subzone; loose blocks from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.
Figs. 4, 5. Laeviuscula Zone; approximately 18 m below top of Massive Sandstones; ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye.

MORTON, Scottish Bajocian ammonites

ribbing; on outer whorls tubercles more distant or less regular and outermost whorls only ribbed; last tubercle at varying diameter, up to 53 mm on GSE 3060; on outer whorls ribbing more regular, branching just below mid-whorl with secondary ribbing on upper part of whorl more prominent, but strength varies; ribs slightly curved on whorl sides, strongly projected ventrally; umbilical edge rounded, venter rounded—fastigate with prominent high keel; sutures complex, with long deeply divided lateral lobe (text-fig. 5I); body chamber mostly not preserved.

Discussion. These specimens differ from *sowerbyi* in that all show disappearance of the tubercles on the phragmocone, and in being slightly less compressed. Most lack body chamber so that it is not possible to predict the ornamentation of the adult whorls. It is possible that they are the inner whorls of *S.* (*Papilliceras*) *mesacantha* (Buckman) described below, but this does not seem likely because of the better-developed ribbing than typical of the inner whorls of *mesacantha*. They are closely comparable with *propinquans* (especially text-figs. 2–4), although Bayle's specimens show more pronounced ribbing. The problem of the lectotype of *propinquans* is discussed by Huf (1968, p. 26) and Westermann and Riccardi (1972, p. 47), with lectotype designation (of Bayle 1878, p. 84, figs. 3–4) attributed to Roman (1938). However, there is an earlier lectotype designation (of Bayle 1878, pl. 84, fig. 1) by Gillet (1937, pp. 30, 32). *Sonninia propinquans* is recorded from Dorset by Buckman (1922), from France by Mouterde *et al.* (1971, p. 11) and from the Basses Alpes by Pavia and Sturani (1968, p. 311), and in other areas from the Sauzei Zone (see also Gillet 1937, p. 29).

Locality. Sauzei Zone and Subzone; loose blocks from the upper part of the Massive Sandstones (identified from the matrix); Rudha Sughar, Bearreraig (except GSE 3060 from south of Bearreraig), Trotternish, Skye.

Sonninia (*Sonninia*) *corrugata* (Sowerby)

Plate 11, figs. 4–9; Plate 12, figs. 6–7; Plate 13, figs. 4–7

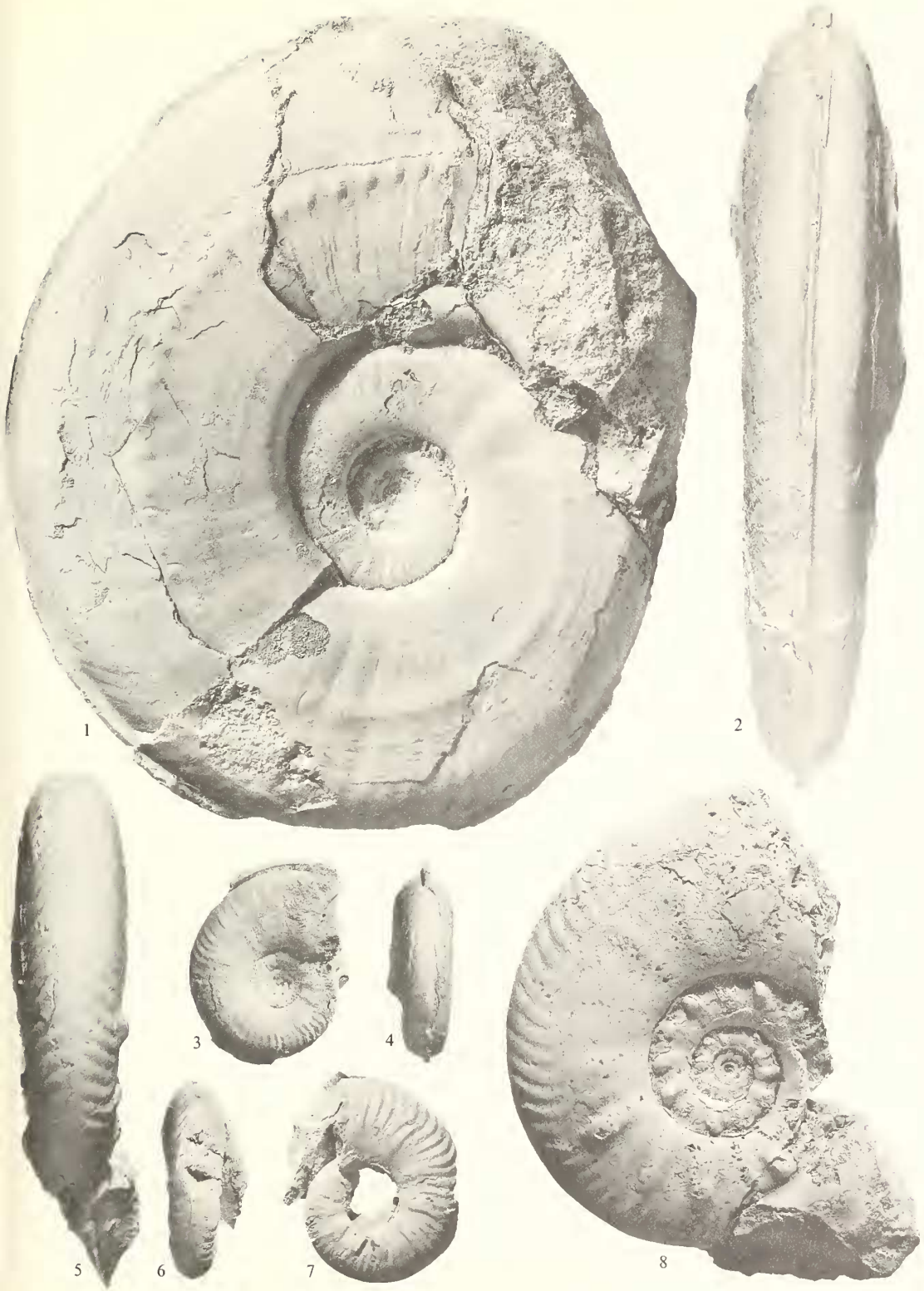
1824 *Ammonites corrugatus* J. de C. Sowerby, p. 74, pl. 451, fig. 3.
non 1885 *Ludwigia corrugata* Sowerby sp., Douvillé, pp. 26–28, pl. 2, figs. 1–5; pl. 3, figs. 1–2 (= *Witchellia sayni* Haug, 1893, p. 308).
1893 *Sonninia corrugata* (Sow.), Haug, p. 283, pl. 8, figs. 1–2.
1908 *Ammonites corrugatus* J. de C. Sowerby, Buckman and Secretary, pl. 4, fig. 4*a*, *b*.
1923 *Sonninia corrugata* J. de C. Sowerby sp., Buckman, pl. 412.
non 1926 *Sonninia corrugata* J. de C. Sowerby sp., Buckman, pl. 412A.
1935 *Witchellia corrugata* Sow., Dorn, pp. 107–108, pl. 5, fig. 4; pl. 9, fig. 2; text-fig. pl. 9, fig. 6.
1937 *Sonninia corrugata* Sowerby, Gillet, pp. 34–35, fig. 24.

EXPLANATION OF PLATE 12

All figures natural size.

Figs. 1, 2. *Sonninia* (*Papilliceras*) *arenata* (Quenstedt); GSE 2912.
Figs. 3, 4, 6, 7. *Sonninia* (*Sonninia*) *corrugata* (Sowerby); 3, 4, HMS 26417/1; 6, 7, HMS 26417/8.
Figs. 5, 8. *Sonninia* (*Sonninia*) cf. *propinquans* (Bayle); GSE 3060.

All specimens from Sauzei Zone and Subzone; loose blocks from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye, figs. 5, 8 from south of Bearreraig.



MORTON, Scottish Bajocian ammonites

1939 *Sonninia corrugata* (Sow.) emend. Dorn, Hiltermann, pp. 163–164, pl. 11, fig. 7; text-figs. 38–39.

1958 *Sonninia corrugata* (Sow.), Oechsle, pp. 117–118.

Material. Thirty-two small specimens, HMS 15340/1–3, HMS 15345/1–5, HMS 26417/1–24, plus small nuclei.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (thirty observations): H = 42·7 (2·2); U = 32·4 (2·2); ^{s}R = 5·9 (1·5); ^{s}Rn = 24·4/½wh (2·7); C = 230 (one specimen only); S = 62·8 (4·8). Maximum measured diameter is 36·9 mm in HMS 15345/1. Regression equations are:

$$\text{Wh} = 0{\cdot}46\ \text{D} - 0{\cdot}54\ [0{\cdot}24]$$
$$\text{Wb} = 0{\cdot}28\ \text{D} + 1{\cdot}22\ [0{\cdot}30]$$
$$\text{Ud} = 0{\cdot}27\ \text{D} + 1{\cdot}11\ [0{\cdot}17]$$

Description. Moderately evolute, not very compressed, small; protoconch large and bulbous; innermost whorls smooth, broader than high, with broad rounded venter and keel by D = 2·0 mm; on intermediate and outer whorls keel more prominent; by D 10·0 mm whorl height greater than breadth; faint broad folds (at D = 3·5 mm) becoming more definite (by D = 7·3 mm) developing into close ribbing at varying diameters (generally greater than 10 mm); ribbing fasciculate from broad blunt folds on lowermost part of whorl sides, usually three ribs developed, sometimes with an extra rib intercalated; ribs slightly curved on whorl sides but projected ventrally, fading on to obtusely fastigate venter without distinct edges; umbilicus moderately broad, edge rounded, vertical, and overhanging in some; suture complex, with long deeply divided lateral lobe and slightly retracted umbilical lobe (text-fig. 5J, K); some have last sutures closer together; body chambers incomplete (except HMS 26417/16 with C = 230°) or not preserved.

Discussion. The specimens are smaller than some others from the same localities. Some are nuclei, others are presumably juveniles, but a few may be adults as suggested by crowding of the last few sutures. They differ from *Witchellia* and *Pelekodites* in whorl shape (less quadrate), fastigate rather than tabulate venter, different style of ribbing, and a much more complex suture line (this last is notable in view of the similarities in size). They differ from inner whorls of *Sonninia* (*Sonninia*) and *Sonninia* (*Papilliceras*) in having body chamber present and well-developed fasciculate ribbing but no tubercles, but shape of venter and complexity of suture are similar. The specimens do not resemble the inner whorls of any of the species of *Sonninia* (either subgenus), but must belong to a distinct small species, possibly of microconchs. They differ from most described species of *Sonninia* in size, and from figured specimens of comparable size in lacking tubercles and having fasciculate ribbing. In these features, and in the shape of the venter, they are similar to *Ammonites corrugatus* Sowerby (1824). The holotype of *corrugata* is wholly septate, while Buckman's specimen (pl. 412 only) has only the beginning of the body chamber preserved, so that the type material cannot be established as microconch. According to Buckman (1923) *S. corrugata* (Sowerby) comes from the *sauzei* hemera (i.e. Sauzei Zone) of Dundry, Somerset.

Localities. (i) HMS 15345/1–5 from Laeviuscula Zone; 18 m below the top of the Massive Sandstones; ledge behind main waterfall in the Bearreraig Burn. (ii) Other specimens from Sauzei Zone and Subzone; upper part of Massive Sandstones; Rudha Sughar, Bearreraig. Both localities are in Trotternish, Skye.

Subgenus SONNINIA (PAPILLICERAS) Buckman, 1920

Type species. Papilliceras papillatum Buckman, 1920, original designation by Buckman (1920, pl. 150).

Includes. Prepapillites Buckman, 1927.

Sonninia (*Papilliceras*) *arenata* (Quenstedt)

Plate 11, figs. 1–2; Plate 12, figs. 1–2

1886 *Ammonites arenatus* Quenstedt, pp. 482–484, pl. 60, fig. 10.
?1927 *Prepapillites arenatus* Quenstedt sp., Buckman, pl. 709.
1935 *Sonninia arenata* Quenstedt, Dorn, pp. 38–39, pl. 7, fig. 1; text-fig. pl. 3, figs. 3–4.
1951 *Papilliceras arenatum* Quenstedt sp., Maubeuge, pp. 49–50, pl. 3, fig. 2.
1958 *Sonninia patella arenata* (Quenstedt), Oechsle, p. 102, pl. 12, fig. 10.
?1964 *Sonninia* (*Papilliceras*) cf. *S. arenata* (Quenstedt), Imlay, p. B34, pl. 6, figs. 1–3.
?1973 *Sonninia* (*Papilliceras*) cf. *S.* (*P.*) *arenata* (Quenstedt), Imlay, p. 68, pl. 26, fig. 11.

Material. Seventeen specimens, HMS 15341/1–3, 6–8, HMS 26394, HMS 26396, HMS 26418/1–3, BkC F329, GSE 2911–2912, GSE 7102, Call. J460.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (sixty-three observations): H = 41·1 (3·4); U = 32·0 (3·8); ^{s}Rn = 34·9/½wh (5·1); T = 7·3 (2·3); Tn = 18·6/½wh (4·4) (on outer whorls only); C = 236·4 (19·1); S = 61·7 (7·9). Maximum measured diameter is 186·4 mm on HMS 26394. H and U vary slightly with growth (see text-fig. 7).

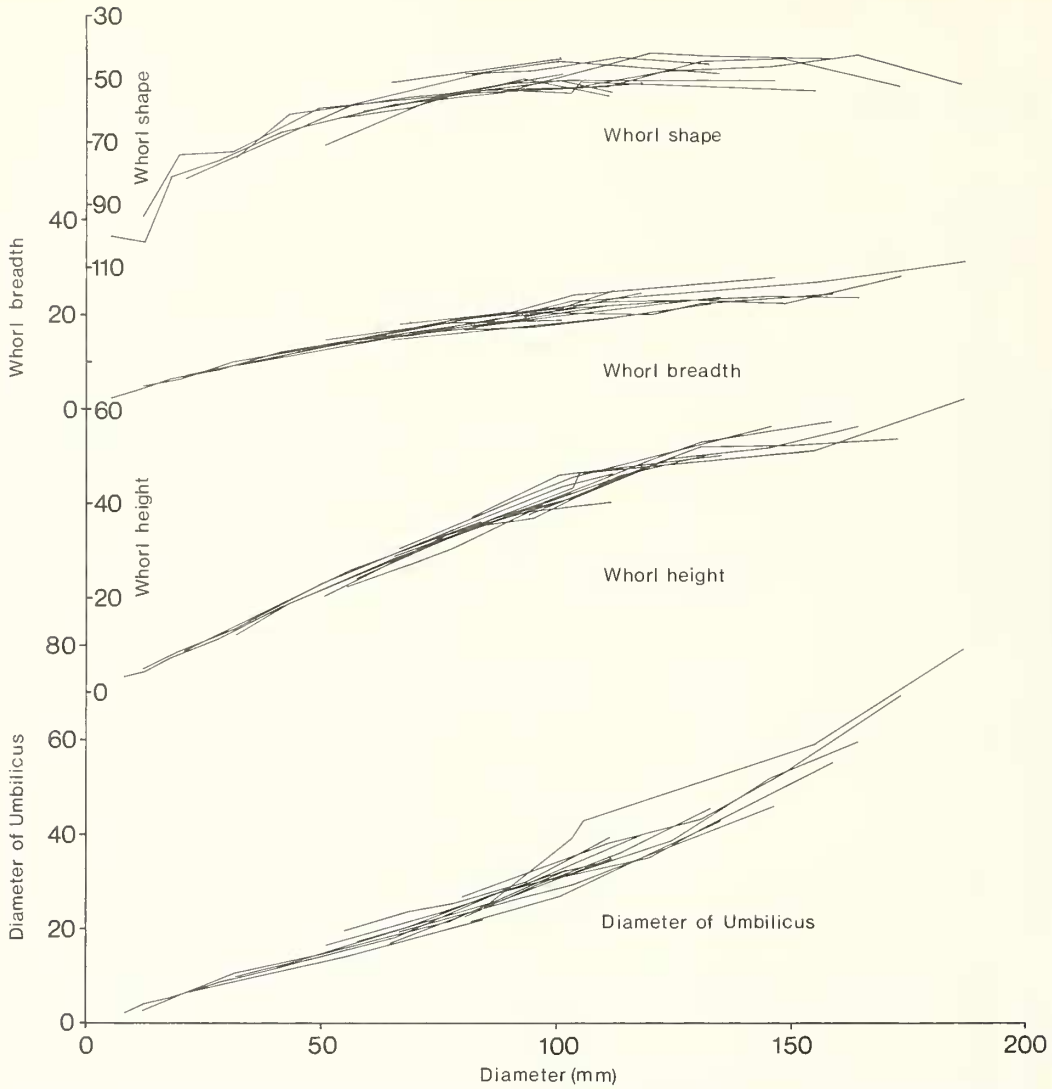
	Aperture	Body chamber	Phragmocone
H	35·0	38·1 (3·5)	42·5 (2·1)
U	37·3	33·9 (3·6)	31·4 (3·4)

Regression equations (see also text-fig. 7) are:

$$Wh = 0{\cdot}34\,D + 5{\cdot}22\ [5{\cdot}65]$$
$$Wb = 0{\cdot}14\,D + 6{\cdot}11\ [4{\cdot}04]$$
$$Ud = 0{\cdot}38\,D - 4{\cdot}26\ [13{\cdot}30]$$

Description. Evolute and compressed, becoming more so with growth; inner whorls as broad as high, with broad rounded venter developing a distinct keel by D 3·5 mm, and with distant blunt tubercles; by D 8·5 mm whorl height exceeds breadth (text-fig. 7) and specimens become suboxyconic when fully grown with whorl sides subparallel; inner whorls with broad blunt ribbing which remains on intermediate whorls where striae may also be developed; ribbing fainter on outer whorls, penultimate whorl of most almost smooth but faintly ribbed on others; at about same stage in growth a faint longitudinal ridge appears on middle of whorl sides and develops on outer whorl into progressively more distinct small tubercles (papillae); on some specimens distinct secondary ribbing develops on upper part of whorl sides; umbilical edge rounded, steep but never vertical; venter not distinct from whorl sides, fastigate with a very high keel, hollow on body chamber but floored on phragmocone; suture extremely complex with long, deeply divided lobes, especially lateral lobe, and very slightly retracted umbilical lobe (text-fig. 8A, B); several specimens with last two or three sutures closer together, complete body chamber and pronounced relative widening of the umbilicus; aperture curved with pronounced ventral projection; three specimens with aptychus preserved inside body chamber (Morton 1973).

Discussion. The specimens are adult macroconchs and the development of the



TEXT-FIG. 7. Umbilical diameter, whorl height, whorl breadth, and whorl shape plotted against diameter for specimens of *Sonninia* (*Papilliceras*) *arenata* (Quenstedt) from Skye.

EXPLANATION OF PLATE 13

All figures natural size.

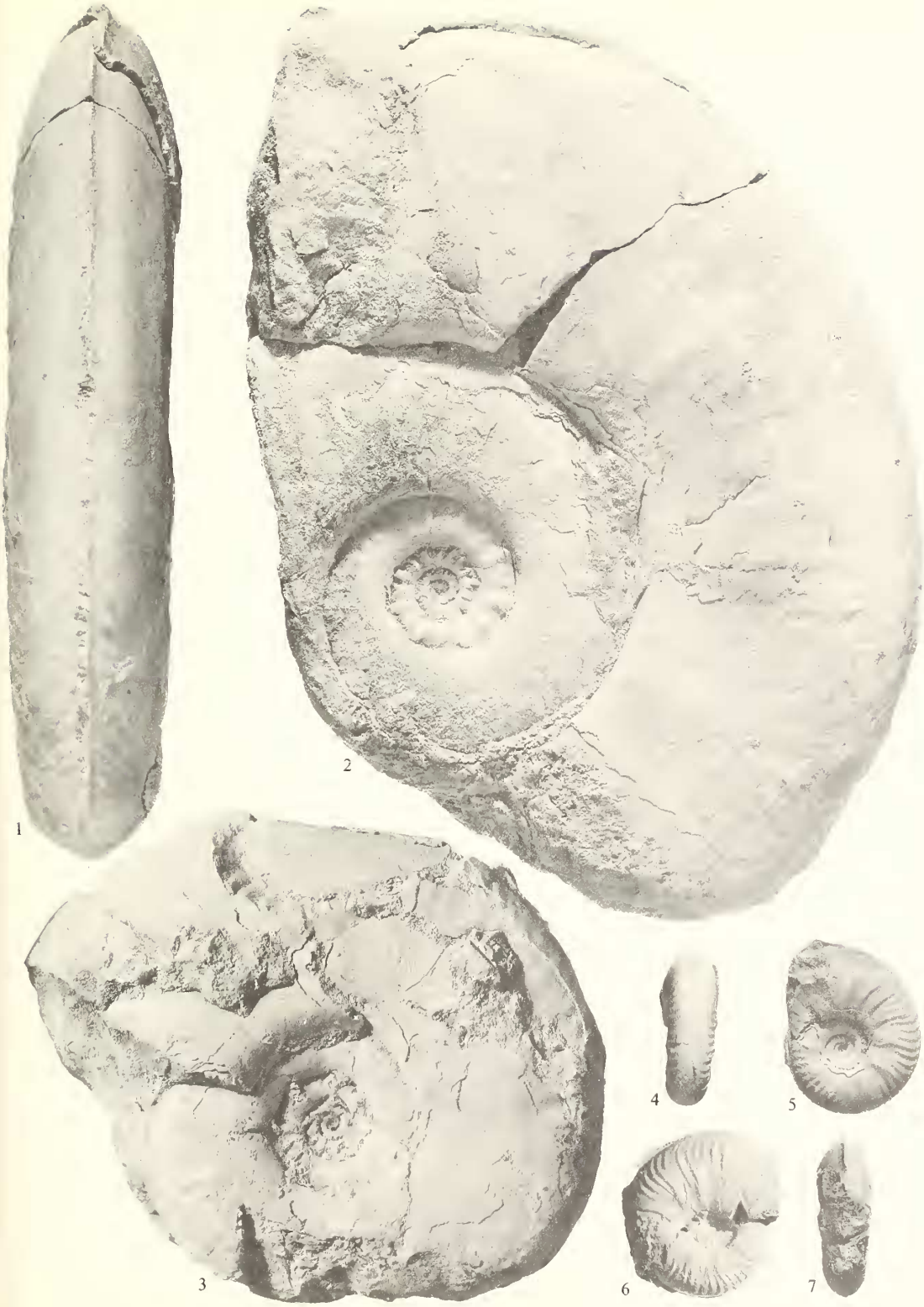
Figs. 1, 2. *Sonninia* (*Papilliceras*) *mesacantha* (Waagen); HMS 26419.

Fig. 3. *Sonninia* (*Papilliceras*) *mesacantha* (Waagen) with aptychus; HMS 26395.

Figs. 4–7. *Sonninia* (*Sonninia*) *corrugata* (Sowerby); 4, 5, HMS 26417/5; 6, 7, HMS 15345/2.

All specimens (except figs. 6, 7) from Sauzei Zone and Subzone; loose blocks from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

Figs. 6, 7, from Laeviuscula Zone; approximately 18 m below top of Massive Sandstones, ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye.



MORTON, Scottish Bajocian ammonites

tubercles on the body chamber is characteristic of *Papilliceras*, though most of the species figured by Buckman (1909–1930) are more strongly ornamented, especially on the inner whorls. They are almost identical in ornamentation, etc., with the holotype of *arenata*, although this specimen is much larger (D = 285 mm according to Dorn 1935, p. 38, cf. 186 mm in HMS 26394). The specimens figured by Buckman (1927) and Imlay (1964), and GSE 2911 have much larger tubercles on the body chamber, and may not belong in this species (see also discussion of *mesacantha* below). *S.* (*P.*) *arenata* was recorded by Quenstedt (1886, p. 482) from Brauner Jura γ and by Dorn (1935, p. 120) from 'unteres Gamma', which is in the Sowerbyi Zone according to Westermann (1967, p. 50). Oechsle (1958, p. 102) states that the type specimen comes from the Blaukalk (i.e. Sauzei Zone) and not the '*sowerbyi*-Zone'. Buckman's specimen comes from the '*Shirbuirnia* hemera', while Mouterde *et al.* (1971, p. 11) record the species from the Laeviuscula Zone. In Skye the species was found in loose blocks from the upper part of the Massive Sandstones, thought to be in the Sauzei Zone.

Locality. Sauzei Zone and Subzone; loose blocks from the upper part of the Massive Sandstones; Rudha Sughar, Bearreraig, Trotternish, Skye. One specimen (Call. J460) was found at the waterfall in the Bearreraig Burn.

Sonninia (*Papilliceras*) *mesacantha* (Waagen)

Plate 13, figs. 1–3; Plate 14, figs. 7–9; Plate 15, fig. 1

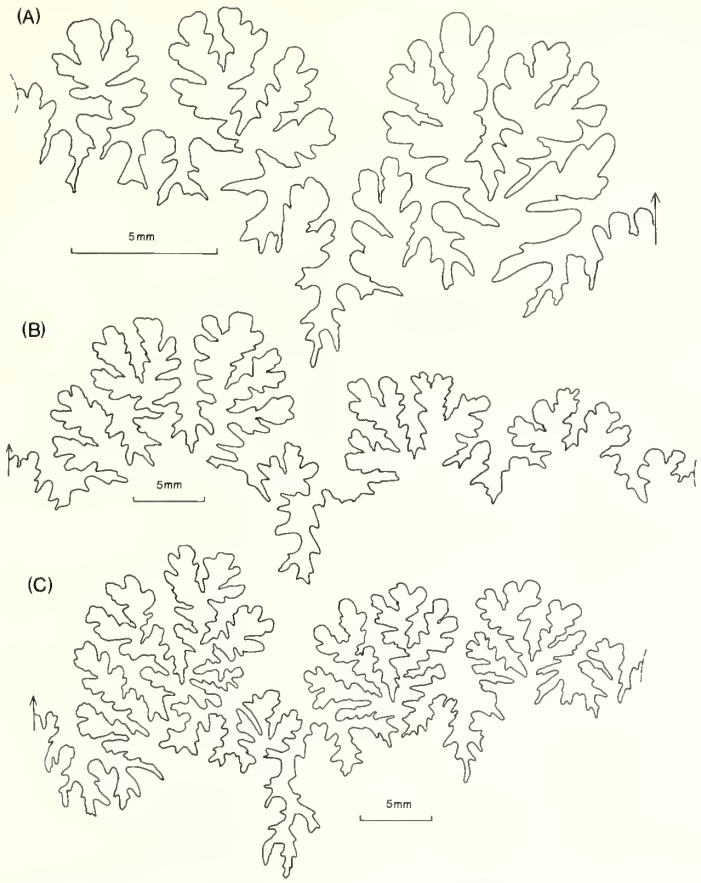
1867 *Ammonites mesacanthus* Waagen, pp. 594–595, pl. 28, fig. 1*a*, *b*.
1885 *Hammatoceras mesacanthum* Waag., Haug, pp. 654–655.
1925 *Papilliceras mesacanthum* Waagen sp., Buckman, pls. 557A, B.
1925 *Papilliceras micracanthicum* Buckman, pl. 611.
1935 *Sonninia mesacantha* Waagen, Dorn, pp. 43–44, pl. 8, figs. 1, 4; text-fig. pl. 4, fig. 1.
1937 *Sonninia mesacantha* Waagen, Gillet, pp. 16–18, fig. 8.
1958 *Sonninia mesacantha* (Waagen), Oechsle, pp. 83–84, pl. 10, fig. 3.

Material. Seven specimens, HMS 26395, HMS 26419, HMS 26420/1–3, GSE 2913, GSE 2971.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (twenty observations): H = 41·1 (2·7); U = 32·1 (2·9); ^{s}Rn = 31·3/½wh (0·9) (on two specimens only); T = 9·1 (5·2); Tn = 16·8/½wh (7·4); C = 240 and 280; S = 62·0 and 63·0 (both C and S measurable only on two specimens). Maximum measured diameter is 165·0 mm on HMS 26419. Regression equations are:

$$\text{Wh} = 0{\cdot}34\ \text{D} + 5{\cdot}52\ [5{\cdot}65]$$
$$\text{Wb} = 0{\cdot}14\ \text{D} + 7{\cdot}29\ [2{\cdot}61]$$
$$\text{Ud} = 0{\cdot}36\ \text{D} - 3{\cdot}64\ [8{\cdot}78]$$

Description. Evolute compressed, but less than *arenata*; inner whorls broader than high with broad rounded venter and high distinct keel by D 8·5 mm; by D 19 mm whorl height exceeds breadth and with growth whorl section becomes more compressed, venter narrower and more acute, and keel more prominent; innermost whorls almost smooth but by D about 8 mm broad, blunt undulations present developing into distinct ribbing and very large tubercles; on middle whorls large tubercles but ribbing less pronounced; on outer whorls tubercles disappear more or less abruptly at varying diameters and generally penultimate whorl (well before end of phragmocone on larger specimens) smooth or striate, sometimes with very faint



TEXT-FIG. 8. Suture lines of A, *Sonninia* (*Papilliceras*) *arenta* (Quenstedt), HMS 15341/2 at Wh 22·3 mm (× 3·8); B, *Sonninia* (*Papilliceras*) *arenata* (Quenstedt), HMS 15341/3 at Wh 40·2 mm (Quenstedt), HMS 15341/3 at Wh 40·2 mm (× 1·8); C, *Sonninia* (*Papilliceras*) *mesacantha* (Waagen), HMS 26420/1 at Wh 38·5 mm (× 1·8).

ribbing; a faint longitudinal ridge (approximately at mid-whorl) develops into distinct small tubercles; outer whorls with whorl sides slightly convex, umbilical edge sharply rounded with umbilical face steep but not vertical; venter fastigate, with very high keel hollow on body chamber but floored on phragmocone; suture highly complex (text-fig. 8C), with long, deeply divided lateral lobe and one other prominent lobe, slightly retracted; body chamber preserved on several specimens, complete on two with part of aperture preserved, and relative widening of umbilicus but no crowding of sutures. One specimen has the aptychus preserved inside the body chamber (see Morton 1973, and Pl. 13, fig. 3).

Discussion. The specimens are mostly adult macroconchs and differ from *arenata* in the presence of prominent tubercles on the inner whorls. The development of the tubercles on the body chamber is very similar in the two species and is characterstic of *Papilliceras*. Of the species referred to *Papilliceras*: *papillata* and *acanthera* have

stronger ornamentation and lack the almost smooth stage, as does *pseudoarenata* (Maubeuge); *arenata* (both Quenstedt's and Buckman's) does not have the tuberculate inner whorls. They are very similar to *mesacantha* and *micracanthica*, although these are almost twice the size. All show tuberculate inner whorls followed by smooth intermediate whorls and then papillate outer whorls. The variation in the Skye specimens, especially in the diameter at which the tubercles on the inner whorls fade, suggests that all belong to the same species, although the holotype of *mesacantha* shows a very short smooth stage between the tuberculate inner whorls and the papillate outer whorls. No data illustrating variation in populations of *mesacantha* are available so that it seems best to group all the specimens discussed above in one species.

Westermann and Riccardi (1972, p. 75) comment on a specimen from Skye which they consider as intermediate between *mesacantha* and *arenata* and suggest that both should be in one species. Similar arguments have been used by Westermann for other sonniniids, and if individual specimens are considered in isolation, or if all European specimens regardless of locality and precise stratigraphical horizon are lumped together then there may be some justification for this view. However, the fact that in the Skye fauna at least there are two distinct types (one with smooth inner whorls, the other with tuberculate inner whorls to varying diameters) suggests that the taxonomic situation is more complex than Westermann's suggestion indicates.

The stratigraphical position of Dorn's specimen (Pl. 8, fig. 1) is doubtful, but Buckman (1925) records his *mesacantha* from the '*sauzei* hemera' and *micracanthica* from the '*propinquans* hemera', both of which would now be regarded as equivalent to the Sauzei Zone. This is the same as given by Waagen (1867, p. 595), confirmed by Oechsle (1958, p. 84), Pavia and Sturani (1968, p. 311), Westermann and Riccardi (1972, pp. 74–75), and most other authors (but cf. Gillet 1937, p. 16).

Locality. Sauzei Zone and Subzone; loose blocks from the upper part of the Massive Sandstones; Rudha Sughar, Bearreraig, Trotternish, Skye.

'*Sonninia*' aff. *furticarinata* (Quenstedt)

Plate 15, fig. 2; Plate 16, figs. 1–2; Plate 17, figs. 3–4

aff. 1858 *Ammonites furticarinatus* Quenstedt, p. 120, pl. 14, fig. 6.
aff. 1886 *Ammonites furticarinatus* Quenstedt, pp. 553–559, pl. 68, figs. 5–8.
aff. 1893 *Sonninia furticarinata* (Quenst.), Haug, pp. 286–287, pl. 8, figs. 3–4.
aff. 1935 *Sonninia furticarinata* Quenstedt, Dorn, pp. 49–50, pl. 20, figs. 1–2; pl. 4, figs. 8–10.
aff. 1958 *Sonninia furticarinata* (Quenstedt), Oechsle, pp. 98–100, pl. 11, figs. 3, 6; pl. 20, fig. 2.

EXPLANATION OF PLATE 14

All figures natural size.

Figs. 1–6. *Sonninia* (*Sonninia*) cf. *propinquans* (Bayle); 1, 2, GSE 2973; 3, 4, GSE 2972.

Figs. 7–9. *Sonninia* (*Papilliceras*) *mesacantha* (Waagen); 7, 8, HMS 26420/2; 9, HMS 26420/1, ventral view of Plate 15, fig. 1.

All specimens from Sauzei Zone and Subzone; loose blocks from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

MORTON, Scottish Bajocian ammonites

Material. Three large specimens and five fragments, HMS 15338, HMS 26421/1-2, HMS 26422/1-2, HMS 26423/1-2, HMS 26424.

Dimensions. For the full list of dimensions see deposited data. Mean and standard deviation for characters which show little variation with growth are (twelve observations): H = 46·2 (2·6); U = 24·3 (4·2); V = 10·6 (1·5); Vb = 39·1 (2·9); S = 58·0 and 67·0 (two specimens only). Maximum measured diameter is c316·0 mm in HMS 15338. Regression equations are:

$$\text{Wh} = 0{\cdot}48\ \text{D} - 2{\cdot}66\ [14{\cdot}98]$$
$$\text{Wb} = 0{\cdot}19\ \text{D} + 9{\cdot}36\ [14{\cdot}06]$$
$$\text{Ud} = 0{\cdot}18\ \text{D} + 7{\cdot}84\ [2{\cdot}34]$$

Description. Large, moderately involute, compressed; by D 4 mm whorl broader than high, distant large blunt tubercles present, and venter broad and carinate-bisulcate; on later whorls height greater than breadth, tubercles develop into broad blunt distant ribs (which sometimes branch low on the whorl sides); on intermediate whorls ribbing gradually fades (by D c60 mm on HMS 15338, by D c85 mm on HMS 26421/1); outer whorls smooth or striate; at about same stage whorl sides almost parallel and venter less well defined, subtabulate and eventually fastigate; high prominent keel throughout; umbilical shoulder sharply rounded, umbilical face approximately vertical; suture complex, with long deeply divided lateral lobe (Pl. 15, fig. 2); body chambers incomplete.

Discussion. The specimens are larger and smoother than most species of sonniniid and seem to be similar only to *furticarinata* (Quenstedt). They are very close to Quenstedt's species in proportions and in ornamentation—with ribbed inner whorls and striate outer whorls, but differ in the bisulcate rather than rounded venter on the inner whorls.

The precise systematic position of these specimens is uncertain. They differ from typical *Sonninia* in ornamentation and the bisulcate becoming obtusely fastigate venter, though they do have a similar complex suture line. The suture is much more complex than that typical of *Dorsetensia*, though the whorl shape and ornamentation of the inner whorls (especially the carinate-bisulcate venter) suggest that they may be related to *Dorsetensia pinguis*, *hannoverana*, and *hebridica* (Morton 1972) with which they occur in part (see also Table 2).

According to Quenstedt (1886, pp. 553–559), Dorn (1935, p. 120), Oechsle (1958, p. 124), and others, '*Sonninia*' *furticarinata* comes from the lower part of Dogger δ in southern Germany, that is, the lower part of the Humphriesianum Zone.

EXPLANATION OF PLATE 15

All figures natural size unless otherwise stated.

Fig. 1. *Sonninia* (*Papilliceras*) *mesacantha* (Waagen); HMS 26420/1; Sauzei Zone and Subzone; loose block from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

Fig. 2. '*Sonninia*' aff. *furticarinata* (Quenstedt); HMS 26423/2; fragment of phragmocone showing suture; ?Hebridica Subzone, Sauzei Zone; loose block from lower 30 m of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye, ×0·75.

Figs. 3, 4. *Emileia* (*Emileia*) sp.; Call. J468; ?Sauzei Zone; loose block from Massive Sandstones, Bearreraig, Trotternish, Skye.

1

2

3

4

MORTON, Scottish Bajocian ammonites

Localities. (i) Hebridica Subzone, Sauzei Zone; basal bed of the Upper Sandstones; foot of cliff east of Torvaig, near Portree (HMS 15358, HMS 26421/1–2). (ii) Sauzei Zone (Hebridica Subzone) or Humphriesianum Zone; loose blocks from the lower 30 m of the Upper Sandstones; Rudha Sughar, Bearreraig (HMS 26422/1–2, HMS 26423/1–2). (iii) Cycloides Subzone, Humphriesianum Zone; lower part of the Upper Sandstones; shore south of Rigg waterfall (HMS 26424). All localities are in Trotternish, Skye.

Genus DORSETENSIA Buckman, 1892

Type species. Ammonites edouardianus d'Orbigny, 1844, original designation by Buckman (1892, p. 302).

Discussion. The genus *Dorsetensia* has been discussed earlier by me (Morton 1972) and by Westermann and Riccardi (1972, pp. 96–105) and Imlay (1973, p. 7) (see also Table 2). The only further comments are that poorly preserved specimens of *D. pinguis* (Roemer) (HMS 26425/1–4) occur in loose blocks from the lower part of the Upper Sandstones at Bearreraig (Pl. 16, fig. 7), and that the maximum size of Skye *Dorsetensia* is less than that of the same species in other areas. Buckman (*in* Lee and Bailey 1925, pp. 105–106) identified four species of *Dorsetensia* from Port nam Marbh, Isle of Mull. These specimens (GSE 2835–2836, 2876–2877) are small and not very well preserved, so that the specific identifications must be treated with reserve, but they are enough to confirm the occurrence of the genus in Mull.

Superfamily STEPHANOCERATACEAE Neumayr, 1875
Family STEPHANOCERATIDAE Neumayr, 1875
Subfamily STEPHANOCERATINAE Neumayr, 1875
Genus EMILEIA Buckman, 1898

Using the same taxonomic procedure for the stephanoceratids as before (Morton 1971*a*, following Westermann 1964), macroconch and microconch subgenera *E.* (*Emileia*) and *E.* (*Otoites*) respectively are recognized.

EXPLANATION OF PLATE 16

All figures natural size unless otherwise stated.

Figs. 1, 2. '*Sonninia*' aff. *furticarinata* (Quenstedt); HMS 26421/1; Hebridica Subzone, Sauzei Zone; basal bed of Upper Sandstones, Torvaig, Trotternish, Skye. 1, ×0·9; 2, ×1.

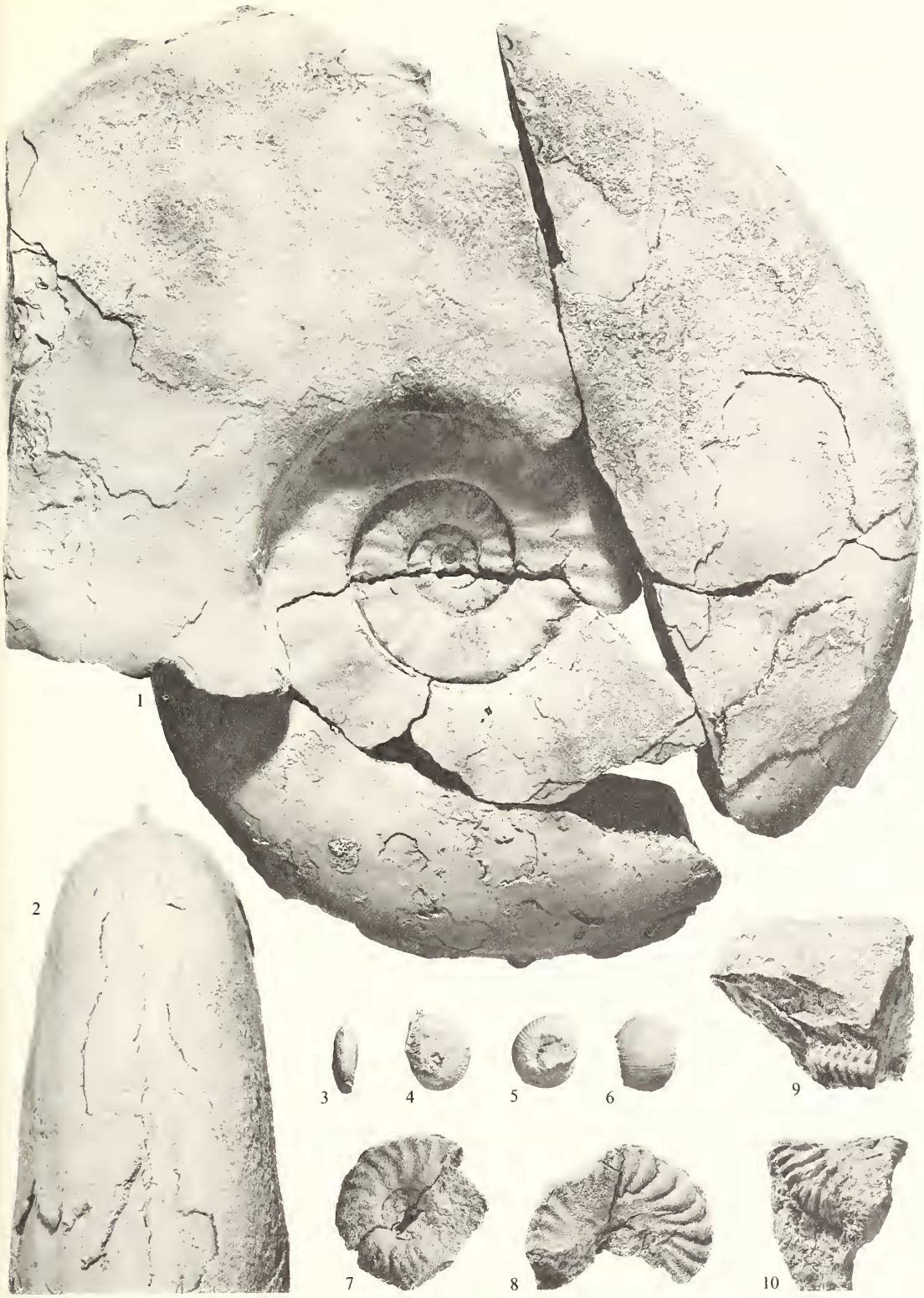
Figs. 3, 4. *Strigoceras bessinum* Brasil; HMS 26428; Sauzei Zone and Subzone; loose block from upper part of Massive Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

Figs. 5, 6. *Emileia* (*Otoites*) sp. nov.; HMS 26426; Laeviuscula Zone; approximately 18 m below top of Massive Sandstones, ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye.

Fig. 7. *Dorsetensia pinguis* (Roemer); HMS 26425/2; Hebridica Subzone, Sauzei Zone; loose block from lower part of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

Fig. 8. *Poecilomorphus cycloides* (d'Orbigny); HMS 26427; Cycloides Subzone, Humphriesianum Zone; lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye.

Figs. 9, 10. *Garantiana* (*Garantiana*) ?*baculata* (Quenstedt) Morton, 1971 = *Pseudogarantiana dichotoma* (Bentz) teste. Pavia, 1973; Subfurcatum or Garantiana Zone; loose block probably from upper part of Upper Sandstones, Bearreraig, Trotternish, Skye.



MORTON, Scottish Bajocian ammonites

Macroconch subgenus EMILEIA (EMILEIA) Buckman, 1898

Type species. Ammonites brocchii J. Sowerby, 1818, original designation by Buckman 1898.

Emileia (*Emileia*) sp.

Plate 15, figs. 3–4

Material. One specimen, Call. J468.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	pRd	pR	pRn	sRn	C
52·0	25·0	48	*c.* 31·0	60	124	*c.* 14·0	27	3·0	6	8/¼wh	30/½wh	[*c.* 240]

Description. Involute, cadicone; venter very broad, rounded not distinct from whorl sides; umbilical edge rounded, overhanging, umbilicus deep; fairly strong primary ribs branch into close faint secondary ribs which are uninterrupted across venter; just under three-quarters of a whorl of body chamber present; aperture not preserved.

Discussion. The specimen is not sufficiently well preserved for definite identification, but the width of the whorls and the strength of the ribbing suggests that it is an *Emileia* rather than an *Otoites*, and it is similar to *subcadiconica* Buckman. *Emileia* occurs mainly in the Sowerbyi and Sauzei Zones (e.g. see Westerman 1964, p. 52).

Locality. ?Sauzei Zone and Subzone; loose block from the Massive Sandstones (judging from the matrix); Bearreraig, Trotternish, Skye.

Microconch subgenus EMILEIA (OTOITES) Mascke, 1907

Type species. Ammonites sauzei d'Orbigny, 1846, original designation by Mascke (1907, p. 23).

Emileia (*Otoites*) sp. nov.

Plate 16, figs. 5–6

Material. One small specimen, HMS 26426.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	Td	T	Tn	sRn	C
12·0	5·7	48	9·5	79	167	3·4	28	1·4	12	11/½wh	29/½wh	[170]

Description. Involute, cadicone; very broad rounded venter separated from lower part of whorl sides by sharply rounded shoulder on which prominent small closely spaced tubercles present; on lower part of whorl sides primary ribs strongly prorsiradiate slightly curved, each terminating in a tubercle; from each tubercle two rectiradiate almost straight secondary ribs branch almost immediately, uninterrupted across venter; suture moderately complex, with second lateral saddle almost as large as first lateral saddle, and umbilical lobe retracted; last four septa approximated; just under half a whorl of body chamber preserved; aperture broken, part of peristome, including lappets, displaced.

Discussion. The specimen seems to be an adult microconch. The style of the ornamentation and the relative size of the umbilicus are typical of *Otoites*. The specimen is much smaller and the ornamentation is closer and finer than the species of *Otoites*

figured by Buckman, Westermann (1954), and other authors, although the closest would be *delicatus* Buckman 1913. It may belong to a new miniature species.

Locality. Laeviuscula Zone; approximately 18 m below the top of the Massive Sandstones; ledge behind main waterfall in Bearreraig Burn, Trotternish, Skye.

Superfamily HAPLOCERATACEAE Zittel, 1884
Family HAPLOCERATIDAE Zittel, 1884
Genus POECILOMORPHUS Buckman, 1889

Type species. Ammonites cycloides d'Orbigny, 1845, original designation by Buckman (1889, p. 115).

Discussion. According to Sturani (1971, p. 99) *Poecilomorphus*, with microconch subgenus *Micropoecilomorphus*, evolved from *Toxamblyites* (Buckman 1924) (misspelt *Toxalambites* by Sturani) and should therefore be placed in the superfamily Haploceratacеae, family Haploceratidae (cf. Arkell 1957). *Poecilormorphus* was also discussed by Huf (1968), although none of the species described by him belong in this genus but rather to *Pelekodites* or *Dorsetensia* (see also Morton 1972), and by Imlay (1973, pp. 7–8, 75).

Poecilomorphus cycloides (d'Orbigny)

Plate 16, fig. 8

1844 *Ammonites cadomensis* (non Defrance) d'Orbigny, pl. 121, figs. 1–6.
1845 *Ammonites cycloides* d'Orbigny, p. 370.
1889 *Poecilomorphus cycloides* (d'Orbigny), Buckman, pp. 117–121, pl. 22.
1971 *Poecilomorphus cycloides* (d'Orbigny), Sturani, pp. 100–110, pl. 8, figs. 1–21; pl. 9, figs. 12–16.

Material. One specimen, HMS 26427.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	Vw	V	Vb	Rd	R	Rn
27·4*	15·5*	60*	9·0*	33*	58*	4·4*	16*	5·0*	18*	56*	3·0	11	13/½wh

Description. Involute; subquadrate whorls (but distorted during compaction); large blunt ribs, strongly rursiradiate but curving forwards on to venter, confined to upper part of whorl sides, fading just below mid-whorl; venter broad, carinate-bisulcate.

Discussion. In spite of the crushing the specimen can be seen to fall within the range of variation of *P. cycloides* as described by Sturani, near typical *cycloides* of Buckman (1927, pp. 9–11). According to Sturani and others, *P. cycloides* is typical of the lower part of the Humphriesianum Zone (Cycloides Subzone).

Locality. Cycloides Subzone, Humphriesianum Zone; lower part of the Upper Sandstones; shore just north of Rigg waterfall, Trotternish, Skye.

Superfamily OPPELIACEAE Bonarelli, 1894
Family STRIGOCERATIDAE Buckman, 1924
Genus STRIGOCERAS Quenstedt, 1886

Type species. Ammonites truellei d'Orbigny, 1845, original designation by Quenstedt (1886, pp. 565–566).

Strigoceras bessinum Brasil

Plate 16, figs. 3–4

1895 *Strigoceras bessinum* Brasil, pp. 43–44, pl. 4, figs. 6–7.
1971 *Strigoceras bessinum* Brasil, Sturani, pp. 118–119, pl. 4, figs. 16–19.

Material. One small specimen, HMS 26428.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U	C
12·6	7·1	56	3·8	30	54	1·6	13	[*c.* 60]

Description. Involute, oxyconic, maximum thickness below mid-whorl; venter acutely fastigate with low keel; smooth or very faint close ribbing; body chamber partly preserved.

Discussion. The specimen is smaller than, but otherwise similar to, *Strigoceras bessinum* Brasil, from the Humphriesianum Zone.

Locality. Sauzei Zone and Subzone; loose block from the uppermost part of the Massive Sandstone, Rudha Sughar, Bearreraig, Trotternish, Skye.

Superfamily PERISPHINCTACEAE Steinmann, 1890
Family PERISPHINCTIDAE Steinmann, 1890
Subfamily ZIGZAGICERATINAE Buckman, 1920
Genus PROCERITES Siemiradzki, 1898

Procerites sp.

Plate 17, figs. 1–2

Material. One specimen, Call. J467.

Dimensions.

D	Wh	H	Wb	B	W	Ud	U
c. 140·0	51·4*	37*	—	—	—	42·8*	31*
122·0*	49·1*	40*	24·2*	20*	49*	*c.* 35·5*	29*

Description. Poorly preserved internal mould of body chamber and part of phragmocone and one inner whorl; broad blunt primary ribs branch near mid-whorl into closer and fainter secondary ribs; ribbing straight, approximately rectiradiate, uninterrupted over venter. On one inside wall of body chamber are several serpulids.

Discussion. The ornamentation is typical of *Procerites*, but the preservation is too poor to allow more precise identification. The presence of the serpulids suggests that the empty shell may have drifted.

EXPLANATION OF PLATE 17

All figures natural size.

Figs. 1, 2. *Procerites* sp.; Call. J467; ?Upper Bajocian; loose block possibly from White Sandstone (Great Estuarine Series), Rudha Sughar, Bearreraig, Trotternish, Skye.

Figs. 3, 4. '*Sonninia*' aff. *furticarinata* (Quenstedt); HMS 26421/1; inner whorls of Plate 16, figs. 1, 2; Hebridica Subzone; Sauzei Zone; basal bed of Upper Sandstones, Torvaig, Trotternish, Skye.

MORTON, Scottish Bajocian ammonites

Locality. The specimen was found by Dr. J. H. Callomon at Rudha Sughar, Bearreraig. The matrix, a medium grey calcareous sandstone with a few dark grey carbonaceous streaks, indicates that it is certainly not derived from the Upper Sandstones, and probably not from the Massive Sandstones. More likely is derivation from the White Sandstone in the Great Estuarine Series, because *Procerites*, though mainly Lower–Middle Bathonian (Arkell 1957, p. L315), does range down into Upper Bajocian but not to Sauzei Zone.

DISCUSSION AND SUMMARY

A modified scheme of Lower Bajocian zones or subzones is used in Skye: Discites, Ovalis, Laeviuscula, Sauzei (with subzones Sauzei and Hebridica), and Humphriesianum (with subzones Cycloides, Humphriesianum, and Blagdeni). The first three are used informally at present to replace Sowerbyi, but Sauzei and Humphriesianum, with these subzones, can be regarded as part of a formal scheme. Revisions of earlier biostratigraphy include: (*a*) redefinition of the base of the Humphriesianum Zone to exclude the newly defined Hebridica Subzone means that the base of the Humphriesianum Zone in Trotternish lies a short distance above the base rather than coinciding with the base of the Upper Sandstones; (*b*) discovery of *Garantiana* in a loose block of the Upper Sandstones means that the base of the Upper Bajocian must lie an unknown distance below the top of the Upper Sandstones.

A modified generic classification of part of the family Sonniniidae is used and discussed: *Euhoploceras* (with subgenera *Euhoploceras* and *Fissilobiceras*), *Shirbuirnia*, *Witchellia*, *Pelekodites*, *Sonninia* (with subgenera *Sonninia* and *Papilliceras*), and *Dorsetensia*. The species represented are described and discussed, as are species of some non-sonniniid genera including *Emileia* (with subgenera *Emileia* and *Otoites*), *Poecilomorphus*, *Strigoceras*, and *Procerites*. The specimen of *Procerites* is possibly from the lower part of the Great Estuarine Series.

There is clearly dimorphism in at least some of the sonniniid faunas from Skye, with proven microconchs and macroconchs in the Laeviuscula Zone and Sauzei Subzone. Possible dimorphism in the Hebridica and Cycloides Subzones has been discussed earlier (Morton 1972). No attempt is made here to deal taxonomically with sonniniid dimorphism other than as separate taxonomic categories; the approach to the problem used by Westermann and Riccardi (1972) could not be used on the Skye faunas because there is no clear indication of which macroconch and microconch 'species' belong together. Even macroconch : microconch subgenera such as used for Skye stephanoceratids (Morton 1971) could not be used, because for example *Pelekodites* (m) occurs with *Witchellia* (M) in the Laeviuscula Zone and with *Sonninia* (M+?m) in the Sauzei Zone. Analysis of the Skye sonniniids in terms of possible dimorphism is summarized in Table 3.

Bajocian Sonniniidae have been extensively monographed in Europe, and one result of this is an excess of available names. Hiltermann (1939, pp. 136–137) listed over 200, and a rough estimate obtained by adding names he missed and new ones since then, even allowing for non-European species and species transferred to other families, would suggest that there must be some 250 specific names available in the family. There are undoubtedly too many names at present and extensive 'lumping' has been taking place, notably by Westermann (e.g. 1966). Westermann's 'lumping' has been discussed in various places in this paper (e.g. discussion of *Euhoploceras*,

TABLE 3. Possible dimorphism of sonniniids from Skye. The numbers in square brackets refer to the sequence of faunas, the numbers in the round brackets refer to the number of specimens of each species.

	Macroconchs	Microconchs
CYCLOIDES SUBZONE [7, 8]	*D. liostraca* (10) '*S.*' aff. *furticarinata* (1)	?*D. romani* (16)
HEBRIDICA SUBZONE [6]	?*D. hebridica* (5) ?*D. hannoverana* (7) '*S.*' aff. *furticarinata* (3)	?*D. pinguis* (15)
SAUZEI SUBZONE [5]	?*S.* (*S.*) cf. *sowerbyi* (1) ?*S.* (*S.*) cf. *propinquans* (11) *S.* (*P.*) *arenata* (17) *S.* (*P.*) *mesacantha* (7)	?*S.* (*S.*) *corrugata* (27) *P. macer* (28)
LAEVIUSCULA ZONE [4]	*W.* aff. *rubra* (54) *W.* aff. *laeviuscula* (1) *W.* aff. *romanoides* (1)	?*S.* (*S.*) *corrugata* (5) *P. macer* (14) *P. zurcheri* (13)
OVALIS ZONE [3]	*E.* (*F.*) *fissilobatum* (10) *E.* (*E.*) sp. (1) *Sh. trigonalis* (1)	?
DISCITES ZONE [1, 2]	*E.* (*E.*) ?*marginata* (1) *E.* (*E.*) ?*dominans* (1) *E.* (*E.*) spp. (3)	?

Witchellia aff. *rubra*, *Sonninia* (*Papilliceras*) *arenata* and *mesacantha*) and has had to be rejected. It is clear that taxonomic revision of European Sonniniidae will have to be based on populations which are carefully controlled stratigraphically and geographically, rather than on a study of individual specimens.

In the discussions of several species (e.g. *Euhoploceras* (*F.*) *fissilobatum*) it was noted that the specimens from Skye were smaller than figured specimens from other localities with which they were being compared. It seems that the Skye sonniniids are slightly dwarfed, with ontogenetic changes tending to appear earlier (i.e. at a smaller diameter).

Acknowledgements. This work was commenced as part of a Ph.D. thesis in the University of Glasgow supervised by Professor T. N. George. Further fieldwork was assisted by the Central Research Fund of the University of London. For the loan of specimens I am grateful to Dr. W. D. I. Rolfe (Hunterian Museum, Glasgow), Dr. J. H. Callomon (University College, London), Dr. R. B. Wilson (Institute of Geological Sciences, Edinburgh), and for donation of specimens to Dr. J. D. Hudson (Leicester), Dr. R. Mouterde (Lyon, France), Dr. G. E. G. Westermann (Hamilton, Canada), and Dr. J. K. Wright (Chelsea College, London). For helpful discussions I thank Dr. J. H. Callomon, Dr. M. K. Howarth (British Museum, London), and Dr. H. S. Torrens (Keele), and I am particularly grateful to Dr. Callomon and Dr. Torrens for their comments on the manuscript. The photographs are by Mr. E. Cory of Birkbeck College, the text-figures are by Mr. J. Richards, and Mr. A. J. Smith obtained the regression equations.

REFERENCES

ANDERSON, F. W. and DUNHAM, K. C. 1966. The geology of Northern Skye. *Mem. geol. Surv. U.K.* (*Scotland*).

ARKELL, W. J. 1951–1959. A monograph of English Bathonian ammonites. *Palaeontogr. Soc.* [*Monogr.*], 1–264, pls. 1–33.

—— 1954. *In* ARKELL, W. J. and PLAYFORD, P. E. 1954. The Bajocian ammonites of Western Australia. *Phil. Trans. roy. Soc.* **237B**, 547–604, pls. 27–40.

—— 1957. *In* MOORE, R. C. (ed.). *Treatise on Invertebrate Paleontology*. Part L, *Mollusca 4*, *Cephalopoda*, *Ammonoidea*. Geol. Soc. Am. and Univ. Kansas Press, L1–L490, 558 figs.

BARKER, M. J. and TORRENS, H. S. 1971. A new ammonite from the southernmost outcrop of the Lower Lincolnshire Limestone (Middle Jurassic). *Trans. Leicester lit. phil. Soc.* **65,** 49–56, pl. 1.

BAYLE, E. 1878. *Explication de la carte géologique de la France*, **4,** Atlas. Paris.

BRASIL, L. 1895. Céphalopodes nouveaux ou peu connus des étages jurassiques de Normandie. *Bull. Soc. géol. Normandie*, **16,** 27–46, pls. 1–4.

BUCKMAN, S. S. 1887–1907. A monograph of the ammonites of the Inferior Oolite Series. *Palaeontogr. Soc.* [*Monogr.*], 1–456, pls. 1–124.

—— 1909–1930. *Yorkshire Type Ammonites* (vols. 1, 2); *Type Ammonites* (vols. 3–7). London and Thame.

—— 1910. Certain Jurassic (Inferior Oolite) species of ammonites and brachiopods. *Q. Jl geol. Soc. Lond.* **66,** 90–108, pls. 9–12.

—— (and SECRETARY) 1909. Illustrations of type specimens of Inferior Oolite ammonites in the Sowerby collection. *Palaeontogr. Soc.* [*Monogr.*], pls. 1–7.

DORN, P. 1935. Die Hammatoceraten, Sonninien, Ludwigien, Dorsetensien und Witchellien des süddeutschen insbesondere frankischen Doggers. *Palaeontographica*, **82A,** 1–124, pls. 1–29.

DOUVILLÉ, H. 1885. Sur quelques fossiles de la zone à *Amm. Sowerbyi* des environs de Toulon. *Bull. Soc. géol. Fr.*, sér. 3, **13,** 12–44, pls. 1–3.

FALLOT, P. and BLANCHET, F. 1923. Observations sur la faune des terrains jurassiques de la région de Cardó et de Tortosa (Province de Tarragone). *Treb. Inst. catal. Hist. nat.* 1921–1922, fasc. II, 73–264, pls. 1–13.

GÈCZY, B. 1966. Ammonoides Jurassiques de Csernye, Montagne Bakony, Hongrie, Part I (Hammatoceratidae). *Geol. Hungarica, Ser. Palaeont.* **34,** 1–276, pls. 1–44.

GILLET, S. 1937. Les ammonites du Bajocien d'Alsace et de Lorraine. *Mém. Serv. Carte géol. Als.-Lorr.* **5,** 1–130, pls. 1–5.

HAUG, E. 1885. Beiträge zu einer Monographie der Ammoniten-gattung *Harpoceras*. *N. Jb. Min. etc., Beil.-Bd.* **3,** 585–722, pls. 11–12.

—— 1893. Étude sur les ammonites des étages moyens du système jurassique. *Bull. Soc. géol. Fr.*, sér. 3, **20,** 277–333, pls. 8–10.

HILTERMANN, H. 1939. Stratigraphie und Palaeontologie der Sonninienschichten von Osnabrück und Bielefeld. I Teil. Stratigraphie und Ammonitenfauna. *Palaeontographica*, **90A,** 109–209, pls. 9–13.

HUF, W. 1968. Über Sonninien und Dorsetensien aus dem Bajocium von Nordwestdeutschland. *Beih. geol. Jb.* **64,** 1–126, pls. 1–51.

IMLAY, R. W. 1964. Middle Jurassic ammonites from the Cook Inlet region, Alaska. *Prof. Pap. U.S. geol. Surv.* **418-B,** 1–61, pls. 1–29.

—— 1973. Middle Jurassic (Bajocian) ammonites from eastern Oregon. Ibid. **756,** 1–100, pls. 1–48.

LEE, G. W. 1920. The Mesozoic rocks of Applecross, Raasay, and North-East Skye. *Mem. geol. Surv.* [*U.K.*] (*Scotland*).

—— and BAILEY, E. B. 1925. The Pre-Tertiary geology of Mull, Loch Aline and Oban. Ibid.

MASCKE, E. 1907. *Die Stephanoceras-Verwandten in den Coronatenschichten von Norddeutschland.* Inaug.-Dissert. Georg-August Universität zu Gottingen, 38 pp.

MAUBEUGE, P. L. 1949. Notes paléontologiques sur quelques ammonites jurassiques rares ou nouvelles de la région frontière franco-luxembourgeoise et de la Lorraine centrale. *Arch. Inst. grand-ducal Lux. sect. Sci. nat. phys. math.* N.S. **18,** 149–178, pls. 1–17.

—— 1951. Les ammonites du Bajocien de la région frontière franco-belge. *Mém. Inst. r. Sci. nat. Belg.* ser. 2, **42,** 1–104, pls. 1–16.

—— 1955. Les ammonites aaléniennes, bajociennes et bathoniennes du Jura suisse septentrionale. *Mém. suisses paléont.* **71,** 1–48, pls. 1–11.

MORTON, N. 1965. The Bearreraig Sandstone Series (Middle Jurassic) of Skye and Raasay. *Scott. J. Geol.* **1,** 189–216.

—— 1969. *In* HUDSON, J. D. and MORTON, N. 1969. *Guide for Western Scotland.* International Field Symposium on the British Jurassic, excursion guides. Keele.

—— 1971*a*. Some Bajocian ammonites from western Scotland. *Palaeontology*, **14,** 266–293, pls. 40–51.

—— 1971*b*. The standard zones of the Aalenian Stage. *Ann. Inst. Geol. Pub. Hungar.* **54,** 433–437.

—— 1972. The Bajocian ammonite *Dorsetensia* in Skye, Scotland. *Palaeontology*, **15,** 504–518, pls. 102–105.

—— 1973. The aptychi of *Sonninia* (Ammonitina) from the Bajocian of Scotland. Ibid. **16,** 195–203, pls. 17–18.

MOUTERDE, R. *et al.* 1971. Les zones du Jurassique en France. *C.R. somm. Séances Soc. géol. Fr.* 1971 (**6**), 76–102.

OECHSLE, E. 1958. Stratigraphie und Ammonitenfauna der Sonninien-Schichten des Filsgebiets. *Palaeontographica*, **111A**, 47–129, pls. 10–20.

ORBIGNY, A. D'. 1942–1951. *Paléontologie française; Terrains jurassiques, I Céphalopodes*. Paris, 642 pp., 234 pls.

PAVIA, G. 1973. Ammoniti del Baiociano superiore di Digne (Francia SE, dip. Basses-Alpes). *Boll. Soc. paleont. ital.* **10**, 75–142, pls. 13–29.

—— and STURANI, C. 1968. Étude biostratigraphique du bajocien des terrains subalpines aux environs de Digne (Basses-Alpes) (note préliminaire). *Boll. Soc. geol. ital.* **87**, 306–316.

QUENSTEDT, F. A. 1858. *Der Jura*. Tübingen, 842 pp., 100 pls.

—— 1886. *Die Ammoniten des schwäbischen Jura. II Band. Der braune Jura*. Stuttgart, 1140 pp., 126 pls.

ROCHÉ, P. 1939. Aalenien et Bajocien du Maconnais et de quelques régions voisines. *Trav. Lab. Géol. Univ. Lyon mém.* **29**, 1–355, pls. 1–13.

ROMAN, F. 1938. *Les ammonites jurassiques et crétacées. Essai de genera*. Paris, 554 pp., 53 pls.

SOWERBY, J. 1812–1822. *Mineral Conchology*, vols. 1–4. London, pls. 1–383.

SOWERBY, J. DE C. 1823–1846. Ibid. vols. 5–7. London, pls. 384–648.

SPATH, L. F. 1936. On Bajocian ammonites and belemnites from eastern Persia (Iran). *Mem. geol. Surv. India Palaeont. indica*, N.S. 22, mem. **3**, 1–21, pl. 1.

STURANI, C. 1971. Ammonites and stratigraphy of the '*Posidonia alpina*' beds of the Venetian Alps. *Mem. Ist Geol. Min. Univ. Padova*, **28**, 1–190, pls. 1–16.

TORRENS, H. S. 1969. Field meeting in the Sherborne–Yeovil district, with an appendix on new Inferior Oolite sections by J. Whicher. *Proc. Geol. Ass.* **80**, 301–330.

WAAGEN, W. 1867. Über die Zone des *Ammonites Sowerbyi*. *Benecke's Geognost.-Palaeont. Beitr.* **1**, 505–665, pls. 24–34.

WESTERMANN, G. E. G. 1954. Monographie der Otoitidae (Ammonoidea). *Beih. geol. Jb.* **15**, 1–364, pls. 1–33.

—— 1964. Sexual-Dimorphismus bei Ammonoideen und seine Bedeutung fur die Taxionomie der Otoitidae (einschliesslich Sphaeroceratinae; Ammonitina, M. Jura). *Palaeontographica*, **124A**, 33–73, pls. 6–9.

—— 1966. Covariation and taxonomy of the Jurassic ammonite *Sonninia adicra* (Waagen). *N. Jb. Geol. Paläont. Abh.* **124**, 289–312.

—— 1967. *Lexique stratigraphique international*, vol. 1, *Europe*, fasc. 5f2, *Allemagne, Jurassique moyen* (*Alpes exclues*). Paris.

—— 1969*a*. The ammonite fauna of the Kialagvik Formation at Wide Bay, Alaska Peninsula. Part II. *Sonninia sowerbyi* Zone (Bajocian). *Bull. Amer. Paleont.* **57**, 1–226, pls. 1–47.

—— (ed.). 1969*b*. Sexual dimorphism in fossil Metazoa and its taxonomic implications. *International Union of Geological Sciences, Ser. A*, **1**.

—— and RICCARDI, A. C. 1972. Middle Jurassic ammonoid fauna and biochronology of the Argentine–Chilean Andes, Part I: Hildoceratoceae. *Palaeontographica*, **140A**, 1–116, pls. 1–31.

N. MORTON

Department of Geology
Birkbeck College
Gresse Street
London, W1P 1PA

Final typescript received 24 June 1974